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STANDARD CHLORINE OF DELAWARE, INC.

100208

GOVERNOR LEA ROAD ● P.O BOX 319 ● DELAWARE CITY, DELAWARE 19706

August 18, 1989

Ms. Diane Wehner
Environmental Scientist
Division of Air & Waste Management
DNREC
715 Grantham Lane
New Castle, Delaware 19720

Dear Ms. Wehner:

Please find enclosed copies of the revised RI/FS Work Plan and Quality Assurance Project Plan (QAPjP) for the Standard Chlorine of Delaware, Inc. facility. Revisions of these documents were based on DNREC's and EPA's review comments on the Work Plan and QAPjP, and the discussions that transpired during our meeting with you on July 12, 1989.

Should you have any questions on these revised documents, please do not hesitate to call me.

Very truly yours,

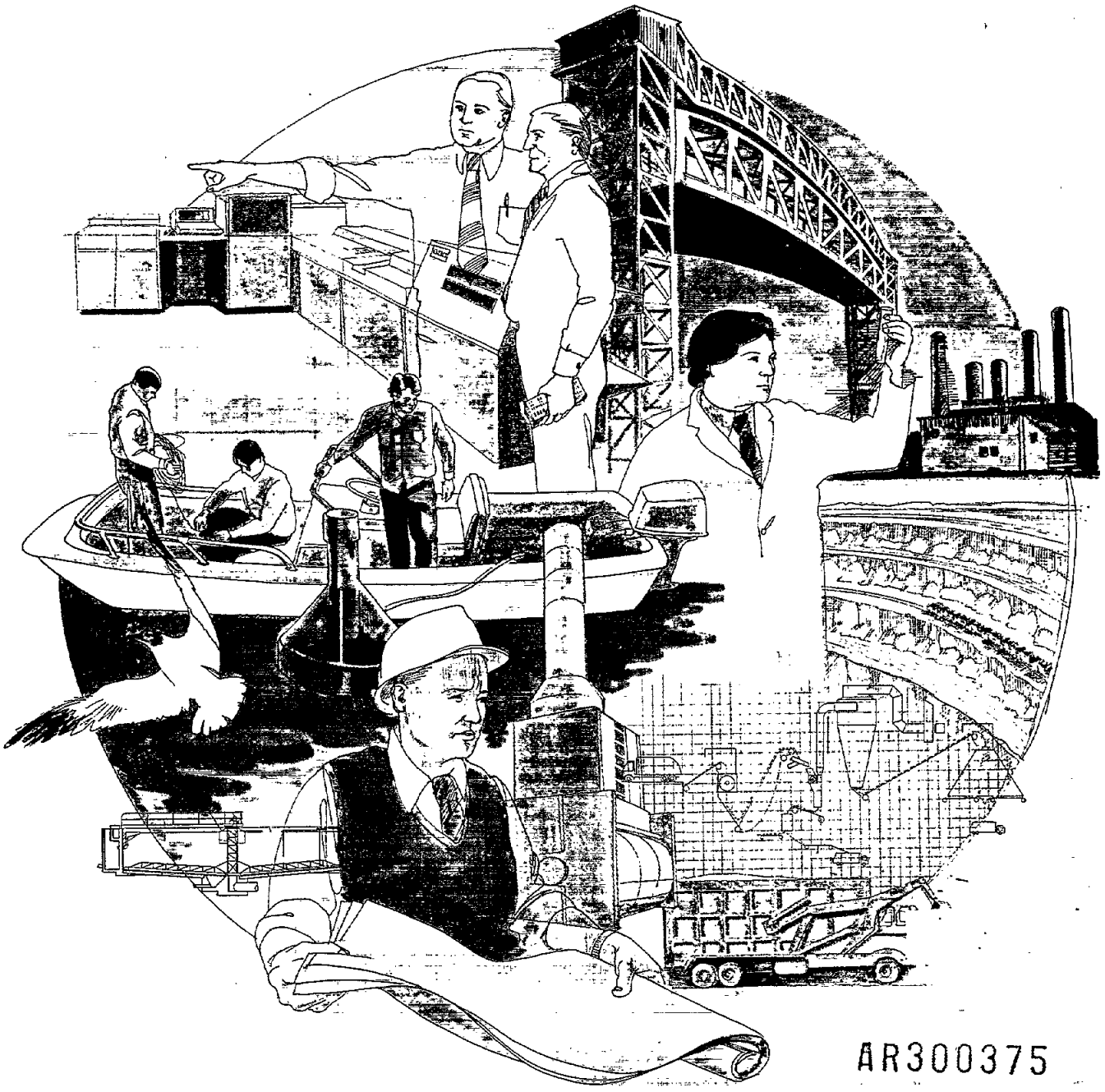
Robert J. Touhey, P.E.
Assistant Vice President
Environmental Affairs

RJT/dab
Enclosures

cc: A. R. Sinibaldi
M. L. Wiener
T. E. Pierson

AR300374

WESTON
MANAGERS DESIGNERS/CONSULTANTS



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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WORK PLAN

STANDARD CHLORINE OF DELAWARE, INC.
DELAWARE CITY, DELAWARE

AUGUST 1989

PREPARED BY

ROY F. WESTON, INC.
WESTON WAY
WEST CHESTER, PENNSYLVANIA 19380

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EXECUTIVE SUMMARY

This work plan outlines the activities which will be conducted for completion of a remedial investigation/ feasibility study (RI/FS) at the Standard Chlorine of Delaware, Inc. (SCD), Delaware City facility. SCD is an active facility which has been manufacturing chlorobenzene products at its current location since 1966. This work plan is part of ongoing remediation activities which have been performed by SCD and its contractor, Roy F. Weston, Inc. (WESTON) following the accidental release of chlorinated benzene products in 1981 and 1986. Extensive cleanup was undertaken by SCD in response to these two spills.

As a result of the 1981 spill, the SCD site was evaluated by the U.S. Environmental Protection Agency (EPA) and the Delaware Department of Natural Resources and Environmental Control (DNREC) and, based upon the results of this evaluation, was placed on the National Priorities List (NPL) in 1985. SCD is now required to complete an RI/FS which meets the requirements of the revised National Contingency Plan (NCP) and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The RI/FS is being conducted under a Consent Order between the DNREC and SCD, as amended 14 November 1988.

The overall objectives of the RI/FS at SCD, as outlined by this Work Plan, are to complete a comprehensive investigation of on-site and off-site contamination, and to evaluate and select remedial action alternatives. A substantial data base already exists from the previous site work and this will be used to the extent possible within validation limits. The areas that will be investigated as part of the RI include:

- On-site surface soils in drainage pathways
- Sediments in the former wetland area
- Sediments and surface water in Red Lion Creek
- Sediments and surface water in the unnamed tributary
- Fauna in Red Lion Creek
- Sediments in drainage areas below the soil staging areas and soils contained within the staging areas.

- Groundwater quality conditions and flow directions in the Columbia Formation and upper Potomac aquifer and the hydraulic relationship between the Columbia and Potomac systems in the vicinity of the SCD facility.

A topographic survey of the site along with on-going control points will be completed to provide a map and area control for the RI/FS. The existing groundwater recovery system will be evaluated to determine overall effectiveness.

Remedial alternatives, that will effectively cleanup or prevent further migration of contamination found in soil, ground water, surface water, and sediment will be developed and evaluated. A remedial action that is technically and environmentally sound, and the most cost-effective will be recommended.

This work plan outlines the means for achieving the RI/FS objectives at SCD by:

- Summarizing the results of previous investigations;
- Identifying data requirements, based on a conceptual site model;
- Describing the RI activities which will be conducted to satisfy those requirements; and by
- Outlining the FS process through which the most appropriate remedial alternatives will be selected.

The RI field activities are presented by this work plan as a scope of work only; detailed protocols are presented in the QAPjP. The work plan concludes with an estimated work schedule, including reporting requirements for accomplishing the RI/FS objectives.

SECTION 1

INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF THE WORK PLAN

The purpose of this work plan is to outline the activities which will be conducted for completion of a remedial investigation/feasibility study (RI/FS) at the Standard Chlorine of Delaware, Inc. (SCD), Delaware City facility. The work plan is part of ongoing remediation activities which have been performed by Roy F. Weston, Inc. (WESTON) under contract to SCD following the accidental release of chlorinated benzene products at the Delaware City facility in 1981 and 1986. As a result of the 16 September 1981 spill, the SCD site was evaluated by the U.S. Environmental Protection Agency (EPA), and the Delaware Department of Natural Resources and Environmental Control (DNREC) and, based upon the results of this evaluation, was placed on the National Priorities List (NPL) in 1985. SCD is now required to complete an RI/FS which meets the requirements of the revised National Contingency Plan (NCP) and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The RI/FS is being conducted under a Consent Order between the DNREC and SCD, original dated 12 January 1988 and amendment dated 14 November 1988.

As a result of the previous investigations, there is a considerable body of qualitative data available concerning the site characteristics, however, additional validated data is required to support the selection of remedial action alternatives. The RI portion of the study focuses on gathering the information necessary to characterize the site with respect to ground water and soils, surface water, and sediments, air quality, ecologic, environmental, and public health issues. The existing data has been used to focus the planned RI activities which will, in turn, provide the information necessary to support the FS selection of remedial action alternatives for the site.

Following the 1981 and 1986 spills of chlorinated benzene products at SCD, remedial actions were taken to mitigate the contaminant releases to the environment. The effectiveness and completeness of these actions will be investigated by this RI and the necessity for further remedial action will be examined by the FS. In particular, the FS will use the site characterization data in conjunction with the perceived assessment of risk to the population and the environment to select alternatives for site remediation.

This work plan has been organized to present the background data and results of previous investigations, to identify data requirements and outline the RI activities to satisfy those requirements and to describe the FS process by which the most appropriate remedial alternative(s) will be selected. The remaining sections of the work plan are structured as follows:

- Section 2 - Environmental Setting. In this section site location, operational history and land use, natural resources and climate are discussed.

- Section 3 - Previous Site Investigations. This section discusses specifics of the 1981 and 1986 spills and describes the remedial work which was performed to mitigate the associated hazard.

- Section 4 - Site Status. This section presents a conceptual model of the site based on data collected in previous investigations, identifies applicable remedial technologies based upon that conceptual site model, identifies the RI data requirements and concludes with the resultant RI/FS objectives for SCD.

- Section 5 - Remedial Investigation. This section outlines the scope of work for conducting the Remedial Investigation. More specifically, the section outlines the investigations of the various media which will be conducted as part of the RI and introduces the risk assessment, which will also be performed. This section is intended as a scope of work only; detailed data collection/analysis protocols and quality assurance guidelines are given in the Quality Assurance Project Plan (QAPjP). The QAPjP for SCD is a separate document which is being submitted as an appendix to this work plan.

- Section 6 - Feasibility Study. This section discusses the identification and screening of remedial technologies and the attainment of remedial action objectives. The development and detailed evaluation of remedial alternatives is explained, as it will be conducted for the determination of the recommended remedial alternative(s) for SCD.

- Section 7 - Scheduling and Reporting. This section presents the estimated work schedule for conducting the RI/FS and establishes the progress reporting protocols.

The Quality Assurance Project Plan (QAPjP), has been developed in conjunction with the Work Plan according to the mandates of the Consent Order. The QAPjP presents all specific protocol necessary for conducting the RI/FS (as outlined by the Work Plan), including the following:

- Project responsibilities,
- Field investigation procedures,
- Field Quality Assurance/Quality Control (QA/QC) guidelines
- Laboratory analytical protocols,
- Laboratory QA/QC guidelines,
- Data management procedures,
- Auditing and preventive maintenance measures, and
- Health and safety requirements.

SECTION 2

ENVIRONMENTAL SETTING

2.1 SITE LOCATION

Standard Chlorine of Delaware, Inc. (SCD) is located approximately three miles northwest of Delaware City, Delaware and is bounded to the north and east by lands owned by Occidental Chemical Company (formerly Diamond Shamrock Company), to the west by Air Products Company, and to the south by Governor Lea Road. A map showing the location of the facility is presented in Figure 2-1.

Red Lion Creek, a 4 mile long tributary of the Delaware River, is located approximately 1000 feet north of the facility and west of the Delaware River. Surface drainage in the area is a dendritic pattern with Red Lion Creek receiving the surface runoff from the facility and surrounding properties. One of the properties upstream of SCD is the Tybout's Corner Landfill, a National Priorities List (NPL) site. The regional topography at SCD ranges from an elevation near sea level in Red Lion Creek to an elevation of approximately 50 feet above mean sea level at the SCD property boundary.

2.2 LAND USE

The SCD facility was constructed in 1965 on virgin farmland purchased from the Diamond Alkaline Company which had purchased the land originally from the Tidewater Refinery Company. The 24-year old facility was developed as the first industrial plant on the site. Air Products Corporation developed the property immediately to the west of the SCD facility, and Occidental Chemical Company has constructed a facility to the east. A Texaco Oil Refinery facility, the first industrial facility in the area, is also located approximately 0.5 miles south of the SCD property.

2.3 SITE OPERATIONAL HISTORY

The plant operations were started in 1966 with the production of chlorinated benzenes. SCD uses benzene and chlorine in its primary reacting systems to form chlorobenzene, paradichlorobenzene, orthodichlorobenzene, and small amounts of metadichlorobenzene and trichlorobenzene. The materials are fed to the reactor on a continuous basis and are removed as a continuous stream. The chlorinated mass that is

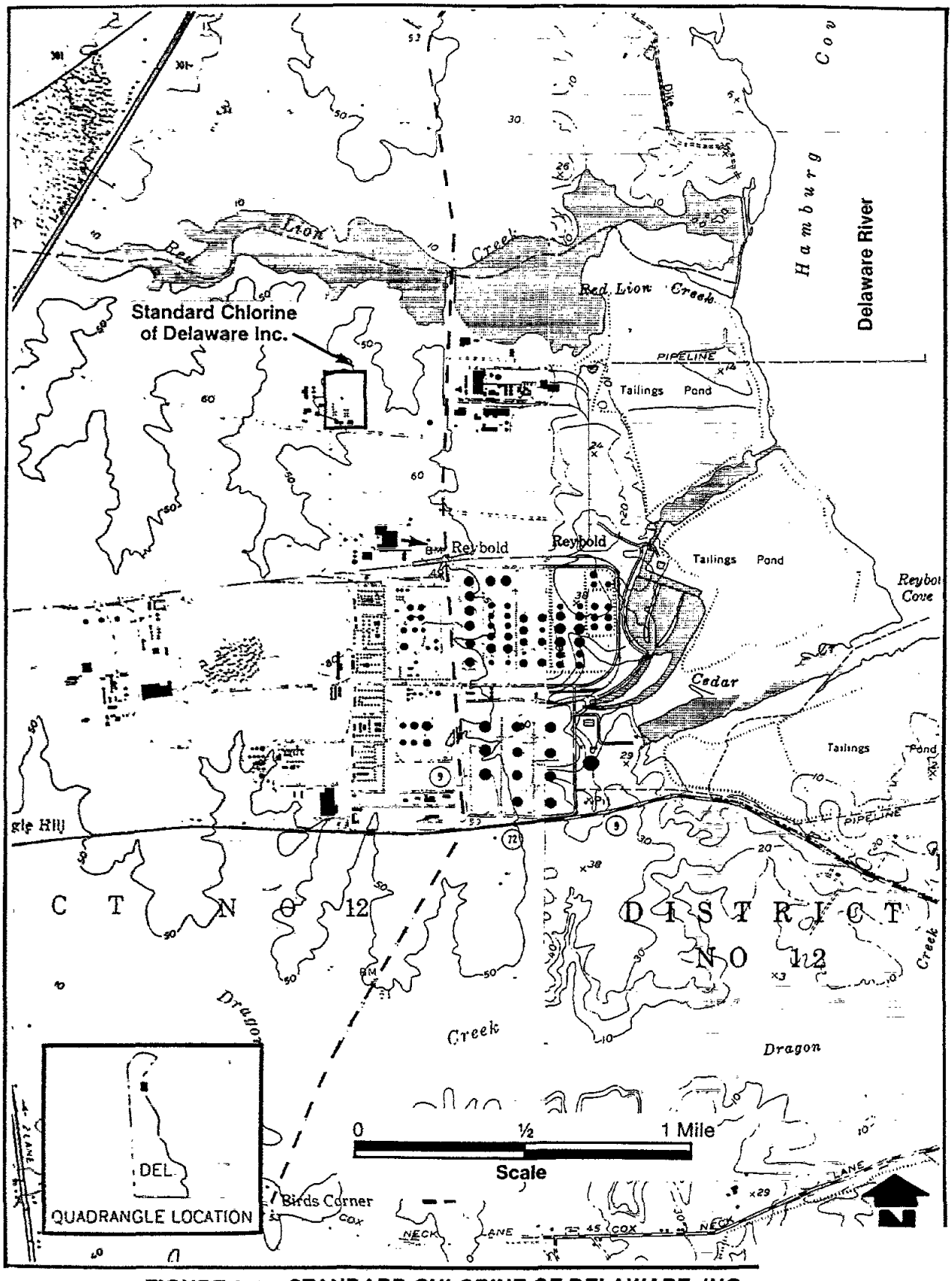


FIGURE 2-1 STANDARD CHLORINE OF DELAWARE, INC. FACILITY LOCATION, DELAWARE CITY, DELAWARE

removed from the reactors is neutralized and sent into distillation/crystallization units where the various products are purified and placed in storage tanks. The reactor also produces hydrochloric acid gas which is sent to an acid manufacturing unit for the production of both 20 and 22 degree Muriatic acid. The processes employed by SCD are totally enclosed.

SCD's reaction process is carried out under acidic conditions at temperatures below 80°C, conditions which do not favor the formation of dioxins and furans. Product separation and purification at SCD are performed under neutral pH conditions and slight vacuum to atmospheric pressures.

The incidental formation of dioxins and furans from suspected precursor compounds such as phenols and chlorinated benzenes requires conditions which will provide sufficient heat, and a source of oxygen necessary to bridge the benzene rings. Favorable conditions, which are contrary to those used by SCD, include a minimum temperature of 180°C and an alkaline environment.

The absence of dioxins and furans in SCD's products has been verified by analysis performed by California Analytical Laboratories. The analysis indicated that no 2,3,7,8-dioxins or furans were present for SCD's primary dichlorobenzene products.

The facility was expanded in the early 1970's for increased production of chlorobenzene, dichlorobenzene and purified trichlorobenzene. Also in the early 1970's the chlorination of nitrobenzene was begun by the facility. This chlorination process consisted of a reacting system, an acid manufacturing unit, and a neutralizing and distillation unit to purify metachloronitrobenzene. In the late 1970's the process was shut down and most of the equipment was converted for chlorobenzene production.

Operational controls at SCD include a wastewater treatment plant, spill containment pad, spill containment areas, continuous monitoring of chlorine unloading facilities, a tank inspection program, and an on-going inspection by an independent consultant for process and manufacturing safety.

In 1977 SCD constructed and placed into operation a wastewater treatment plant to meet the requirements of a NPDES permit. In 1986 a ground water recovery unit [illegible] added on-line to the wastewater treatment plant ground water problems.

The production capacity of the plant was again increased in the late 1970's. Since that time, SCD has continuously produced chlorobenzene, paradichlorobenzene, orthodichlorobenzene, metadichlorobenzene, purified 1,2,4-trichlorobenzene, technical trichlorobenzene and some functional insulating fluids based on chlorobenzenes.

In the mid-1980's a calcium chloride plant was put on line. This system utilizes excess Muriatic acid and limestone for the production of a 35% calcium chloride solution which is sold to distributors.

In the early 1980's SCD installed a spill containment pad under the railroad loading facilities to augment the spill containment truck loading facilities installed in the late 1970's. In the middle 1980's, SCD embarked on a program of increasing the capacity of the containment areas for storage tanks to 110% of the largest tank, plus six inches.

The 1981 and 1986 spills of chlorobenzene products and the leakage of Catch Basin No. 1 (CB1) which occurred at SCD are discussed in detail in the following section.

2.4 CLIMATE

The climate of Delaware City and vicinity can be classified as continental; this is characterized by well defined seasons, moderate rainfall and a large annual temperature range. The close proximity of the Atlantic Ocean does influence the climate of Delaware City to a small extent. The summer seasons are marked by an increase in the relative humidity, while the winters are slightly milder than locations further inland.

The prevailing winds in the vicinity of Delaware City are from the northwest; through the summer months, winds from the southwest are common. The average wind speed is 8.6 miles per hour (mph). Normal precipitation is 44.5 inches per year; normal winter snowfall is 17 inches per year. The seasonal distribution of rainfall is uniform, with August being the wettest month and February being the driest. The precipitation in August is attributed to thunderstorms or, less frequently, to tropical storms. The average yearly temperature is 64.6°F. In the summer the average temperature is 75°F, and in the winter it is 33°F. Summer maximum temperatures exceed 86°F, while winter minimum temperatures fall to 26°F.

2.5 NATURAL RESOURCES

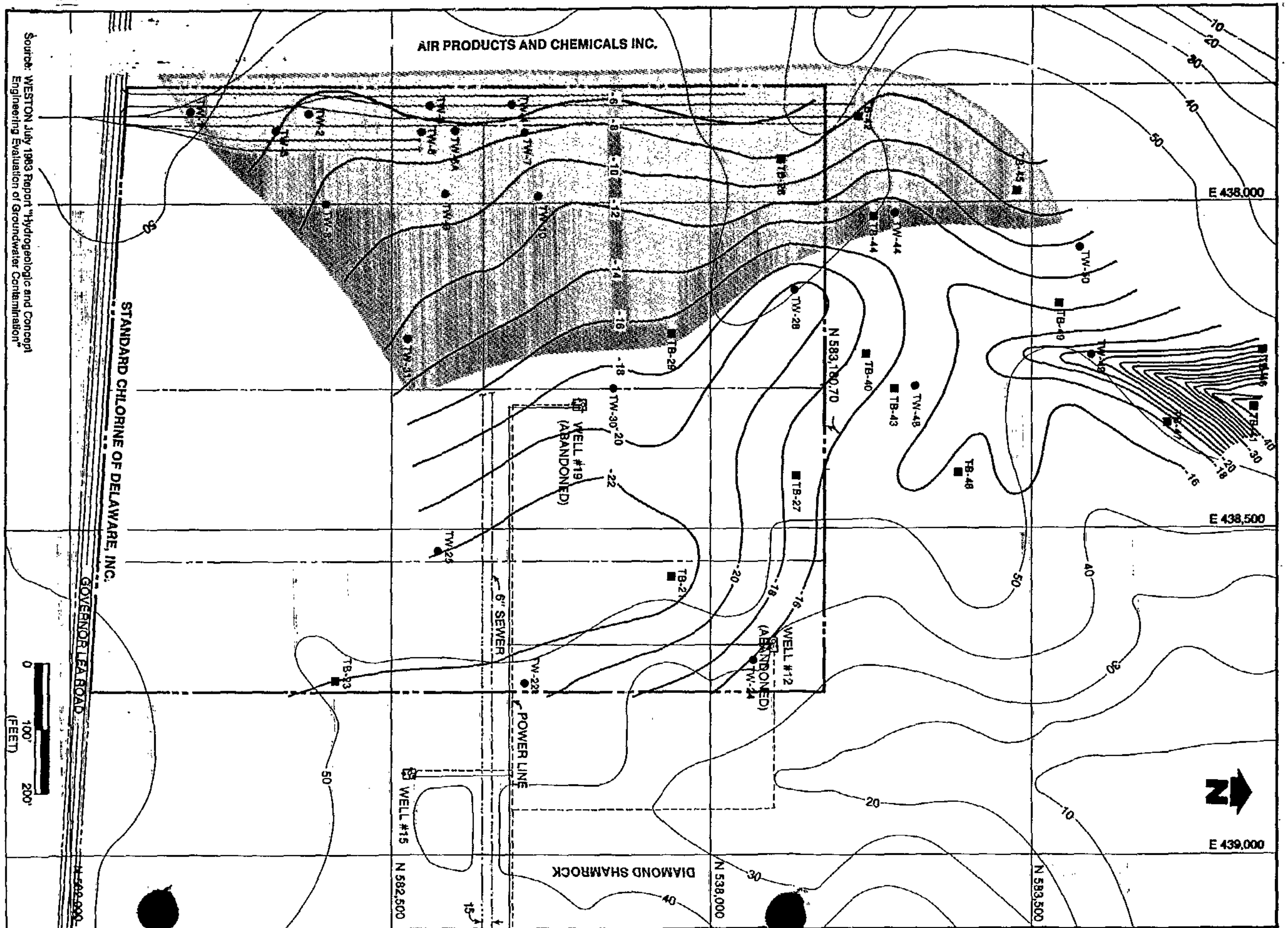
The SCD facility and vicinity are underlain by shallow and deep aquifer systems. The shallow unconfined Columbia aquifer is composed of Pleistocene age sediments and appears to be partially connected to the Delaware River and its associated creeks. In vicinity of surface water bodies, the Columbia aquifer grades to a highly organic silty clay. The Columbia aquifer is characterized by sand, and gravel with some clay and silt, and normally functions as a water table aquifer with sediment thickness greater than 40 feet.

Lithologic logs from soil borings drilled during previous site investigations indicate that the Columbia Formation at the SCD facility is underlain by a continuous layer of Cretaceous age Potomac Formation clay or the Merchantville Formation, consisting previously of dark glauconite clay. Figure 2-2 presents a topographic map of the surface of the Cretaceous age Potomac and Merchantville Formations that was presented in the report entitled "Hydrogeologic and Concept Engineering Evaluation of Ground Water Contamination," dated 29 July 1983. This map shows a topographic relief of about 14 feet at the SCD property, and a steep erosional gulley occurring in the Cretaceous surface at boring TB-41. The location of the Merchantville Formation on the western side of the plant is also shown on Figure 2-2. A geologic cross section (A-A', see Figure 2-3) through the SCD facility illustrates the subsurface conditions as shown in Figure 2-4. A study of permits for wells in the vicinity of the SCD facility indicates that no wells are known to draw water from the Columbia Formation. Based on water level data collected at the facility and adjoining properties, the water table gradient in the Columbia Formation is in a northerly direction toward Red Lion Creek.

The deep confined Potomac Group of aquifers underlie the Columbia Formation at the SCD facility. A confining layer of predominantly clay and silt exists between the Columbia Formation and the upper Potomac aquifer at the site and vicinity, and is on the order of 50 to 80 feet thick. This clay unit acts as a continuous barrier between the Columbia and upper Potomac aquifers. The Potomac Group, which is comprised of three separate but ill-defined aquifers, designated as the upper, middle, and lower Potomac aquifers, is characterized by silty clays, interbedded with sand which acts as the major water bearing body. The formation dips and increases in depth in a southeasterly direction. All three Potomac aquifers function as water sources for domestic, municipal and industrial use in New Castle County

FIGURE 2-2 TO[illegible] SU[illegible] IND[illegible] SUB[illegible]

[illegible]ACEOUS PATTERN [illegible]TVILLE FM.



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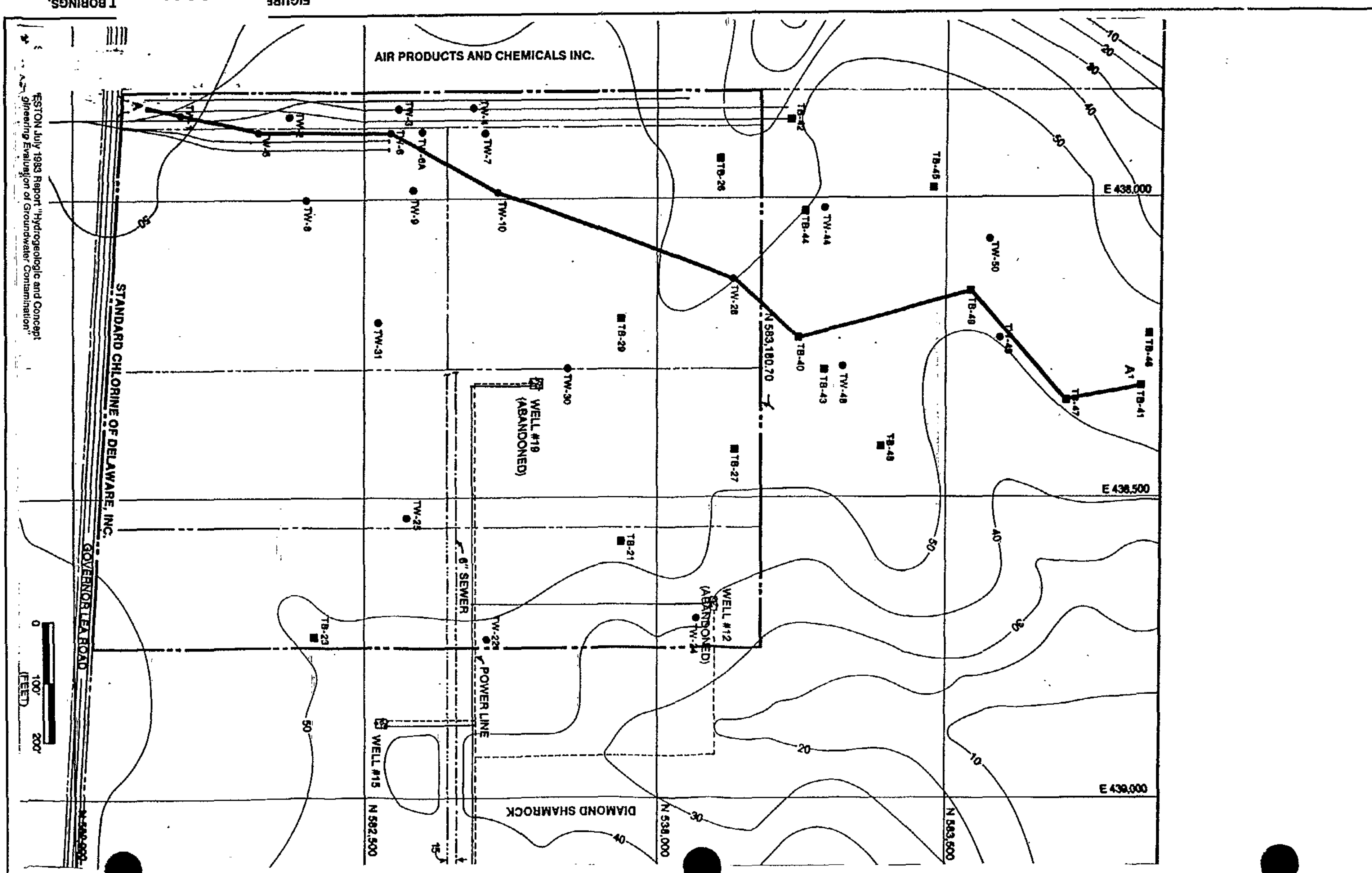

FIGURE 2-7

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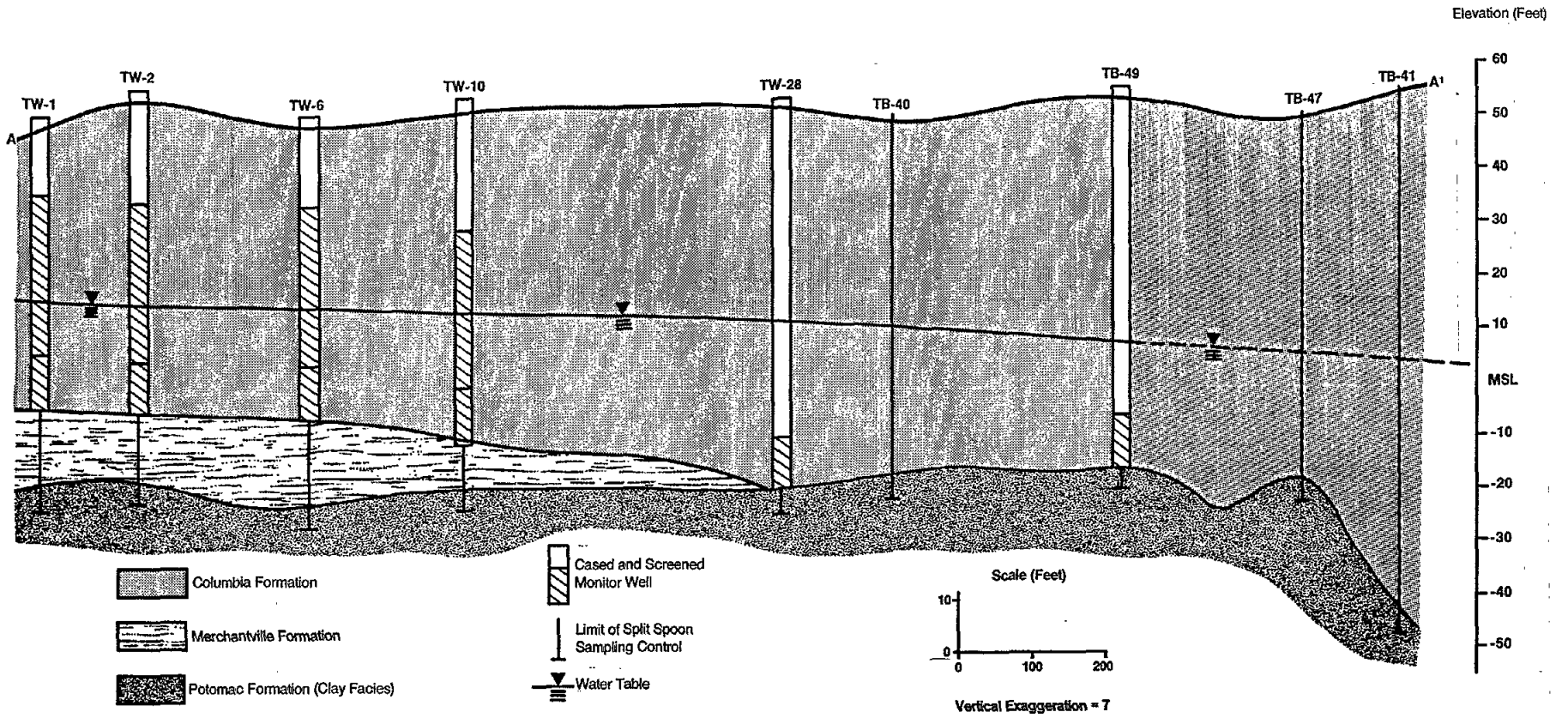

Source: WESTON July 1983 Report "Hydrogeologic and Concept Eng neering Evaluation of Groundwater Contamination"

FIGURE 2-4

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Due to the increased rate of pumpage in the Potomac aquifers in the past 20 years, there has been a gradient reversal in the outcrop zones of the aquifers, causing intrusion of Delaware River water. As a result, a degradation in ground water quality has been observed.

Based on published reports, the Columbia and Potomac aquifers are separated by an approximately 110-foot thick clay confining unit of the Potomac Formation in the vicinity of the SCD facility. The confining Potomac clay zone has been shown to be present at a depth of approximately 70 feet in all boring locations in the SCD facility and is thus considered a continuous barrier between the Columbia and upper Potomac aquifers.

Red Lion Creek and its tributaries were formerly tidal, but are now isolated from the Delaware River by means of a gate, causing most of the creek bed to become wetlands supporting abundant flora and fauna.

SECTION 3

PREVIOUS SITE INVESTIGATIONS

3.1 1981 SPILL AND RELATED REMEDIAL WORK

A spill of industrial grade monochlorobenzene (MCB) occurred at the Standard Chlorine of Delaware, Inc. plant on 16 September 1981. The spill occurred while filling a railroad tank car and the chemical was discharged to the ground around the siding (see Figure 3-1). The estimated volume of MCB spilled was as much as 5,000 gallons. In addition to contaminating the ground in the area of the railroad siding, some of the spillage ran off in surface ditches toward the tributary to Red Lion Creek.

Standard Chlorine of Delaware, Inc. (SCD) took the following actions in response to this spill:

- SCD took prompt action to contain and recover the surface runoff of the spill in order to minimize the discharge of contamination to the surface waters of Red Lion Creek.

- Based upon sampling and analysis of surface soils in the drainage ditch, and under the supervision of DNREC, SCD recovered and disposed of MCB-contaminated surface soils at an off-site permitted commercial facility.

- SCD conducted a subsurface test program in the vicinity of the spill in order to determine the presence of subsurface contamination (see Figure 3-2). Based upon this investigation, DNREC and SCD concluded that the potential existed for contamination of the ground water underlying the site.

As a result of the subsurface investigation, SCD contracted with Roy F. Weston Inc. (WESTON) to provide technical services in the investigation of this incident. SCD and WESTON subsequently completed the following Remedial Investigations and corrective actions:

- WESTON performed a field investigation and assessment of the spill, documenting the findings in a June 25, 1982, report entitled "Hydrogeological and Concept Engineering

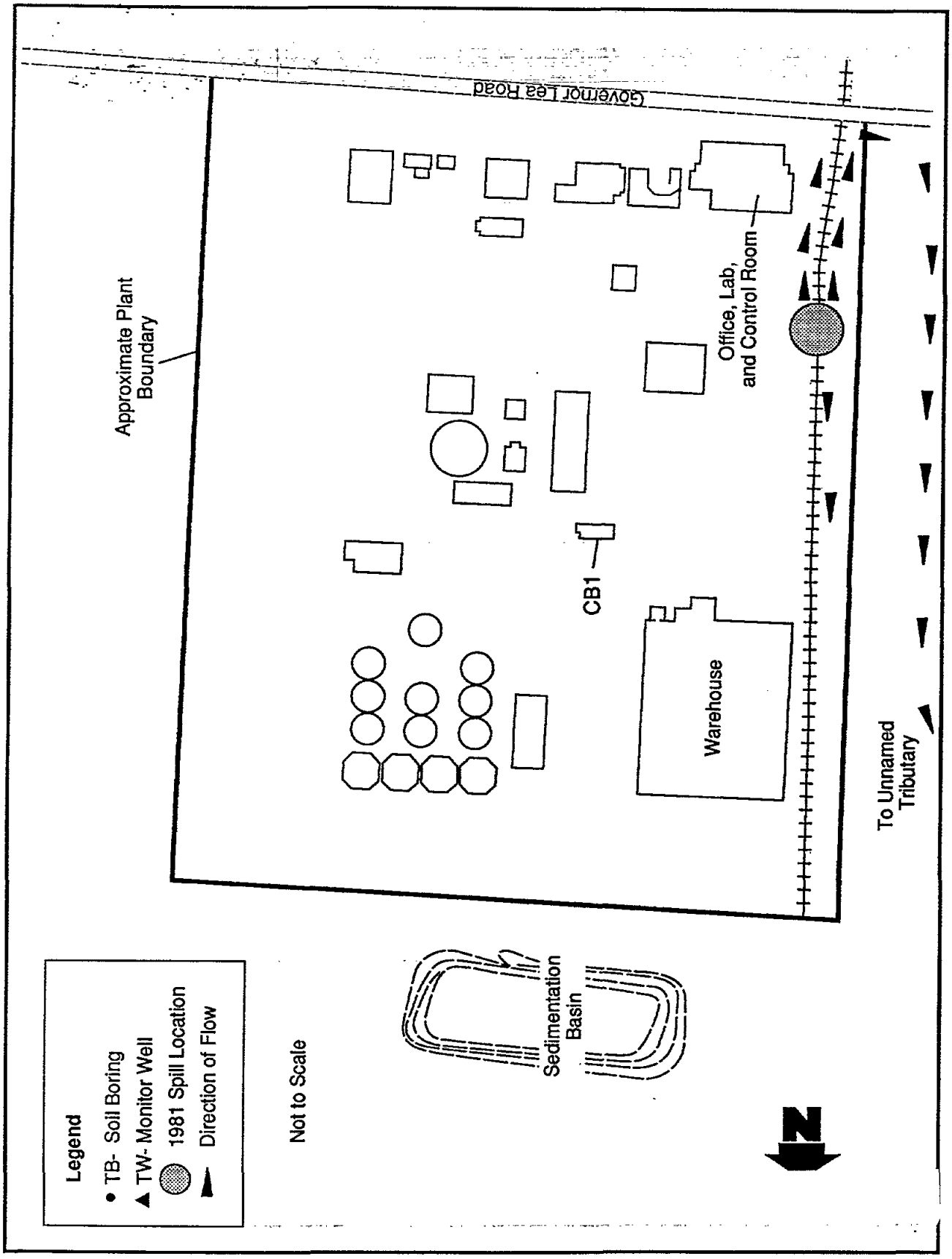


FIGURE 3-1 APPROXIMATE 1981 SPILL FLOW PATHWAY STANDARD CHLORINE OF DELAWARE, INC.

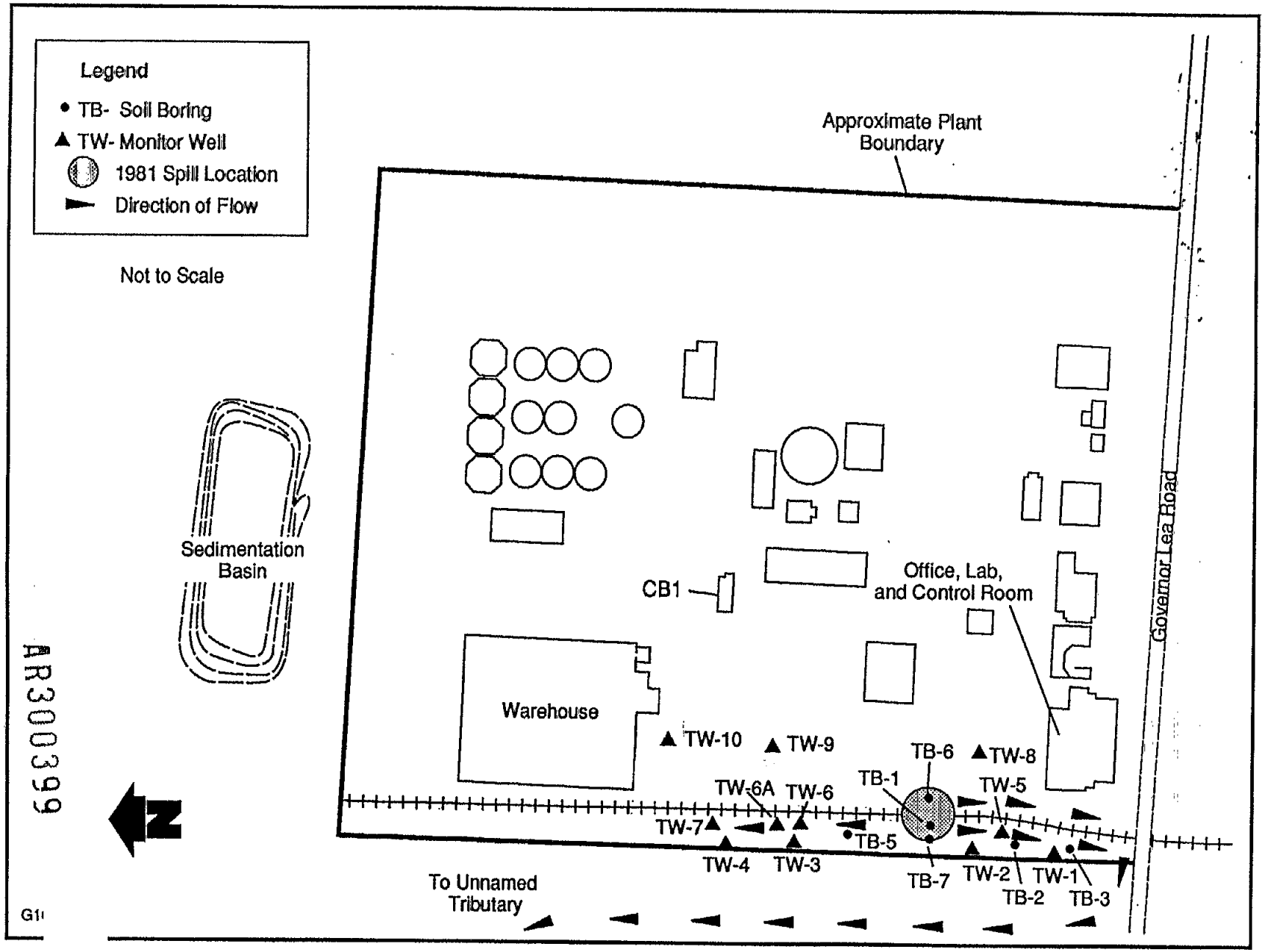


FIGURE 3-2 SOIL BORINGS AND MONITOR WELLS FOLLOWING 1981 SPILL STANDARD CHLORINE OF DELAWARE, INC,

Evaluation of Remedial Actions for a Monochlorobenzene Spill". Ten (10) ground water monitoring wells were installed on-site and sampled during this investigation (see Figure 3-2).

- Ground water sampling/analysis performed during the field investigation indicated the presence of other chlorinated benzene products in ground water. Although DNREC has been notified of other spills/releases on-site, the primary source for the other chlorinated benzene products was attributed to the leaking of a process drainage catch basin (Catch Basin No. 1), which had occurred and was remediated in March of 1976 (CB1 is shown on Figure 3-3). The Catch Basin No. 1 (CB1) collects process drainage by means of an underground sewer pipe. CB1 functions as a settling unit, in which the heavier chlorinated benzenes settle and the lighter water components float. The settled chlorinated benzenes are recycled to the process and the lighter water components are discharged to the wastewater treatment unit. Following detection of the leak, the basin was excavated and replaced, along with a portion of the underground line discharging into it. Annual inspections of the integrity of the new CB1 are conducted and recorded. Those records of annual diggings and observations surrounding the tank were examined as part of this on-site work.

- WESTON completed an additional investigation of the extent of off-site contamination and an evaluation of corrective action alternatives for the ground water contamination. This work included the installation of ten additional ground water monitor wells (see Figure 3-3). The results of this work were documented in a July 29, 1983, report entitled "Hydrogeological and Concept Engineering Evaluation of Ground Water Contamination". This report recommended the implementation of a hydrodynamic barrier and ground water recovery system with treatment of the recovered ground water using air stripping.

- WESTON recommended that an expansion of SCD's existing industrial wastewater treatment plant would be required for treatment of the recovered ground water. The expansion would incl
air stripping tower to remove gr
contaminants prior to mixing with the p

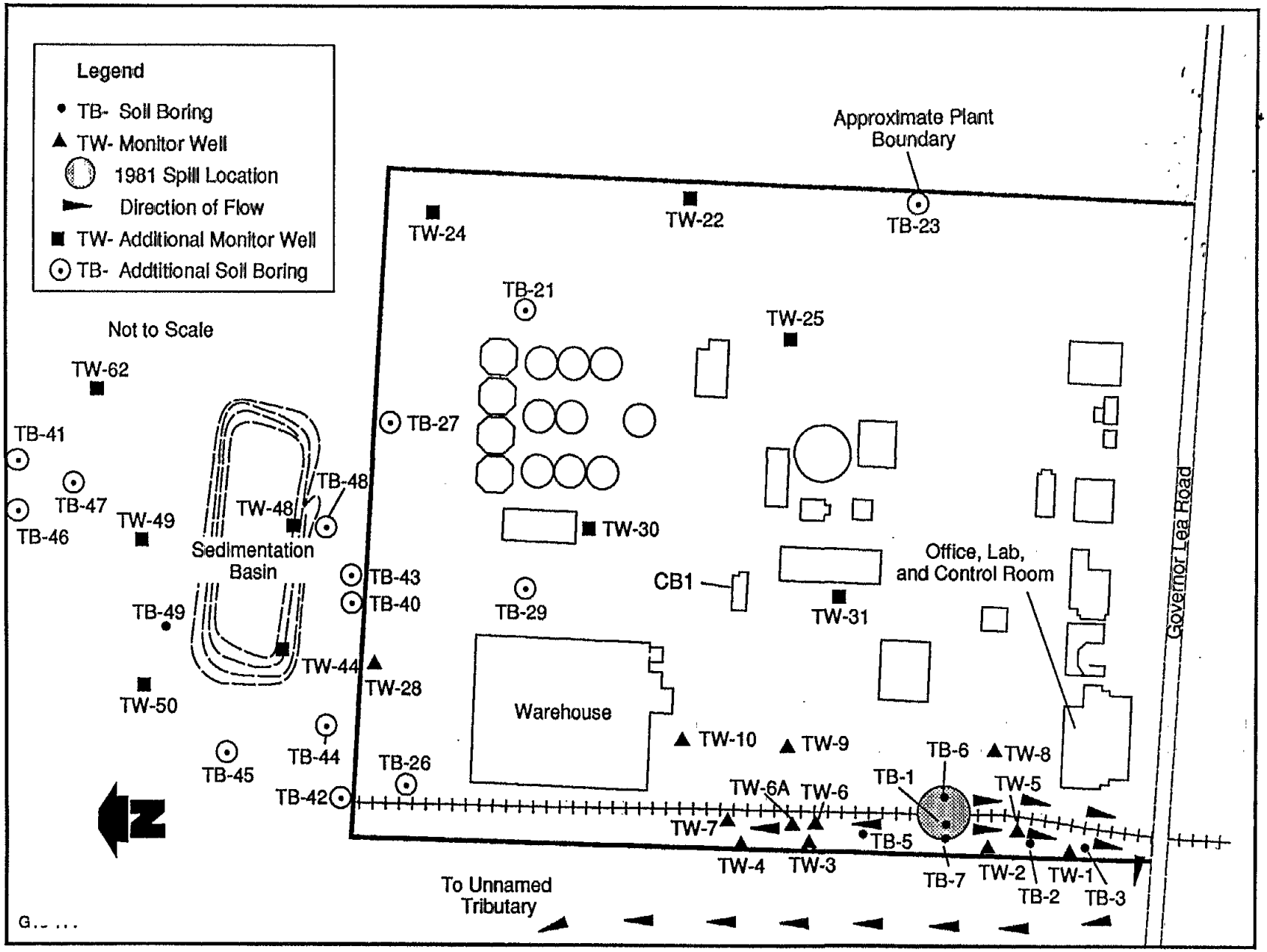


FIGURE 3-3 ADDITIONAL SOIL BORINGS AND MONITOR WELLS FOLLOWING 1981 SPILL STANDARD CHLORIN[illegible]F DELAWARE, INC,

wastewater stream, and 2) an additional clarifier/tertiary sand filter to accommodate the increased combined flow.

- WESTON completed an evaluation of control options for air emissions from the proposed air stripping unit associated with the ground water treatment system. The results of this evaluation were presented in a September 14, 1983 report entitled "An Assessment of the Ambient Air Quality Impact of the Controlled Air Emissions from Standard Chlorine's Proposed Air Stripping Tower". The selected control strategy recommended that the air stripping exhaust gases be vented to an existing process boiler.

- WESTON completed an evaluation of ground water treatment options, including the resulting increased effluent flow from SCD's NPDES outfall. The NPDES permit regulates the effluent discharged to the Delaware River to an average maximum of 1.0 MGD current and limits the concentrations of benzene and derivatives, BOD, TSS, and selected metals. The NPDES permit, which was issued in 1985, expired in May 1989, and has been administratively extended pending renewel. The results of the WESTON evaluation were presented in a September 1984 report entitled, "Feasibility Study and Final Design Report, Standard Chlorine of Delaware, Inc."

- Standard Chlorine implemented the recommendations of the WESTON studies, which required issuance of various permits. An emergency construction permit for the treatment plant modifications was issued by the Delaware River Basin Commission (DRBC) on December 18, 1984. The NPDES permit for the treatment plant modifications and increased discharge flow (from 0.48 to 1.0 MGD) was issued by DNREC on January 21, 1985. The DRBC approved DNREC withdrawal permits for the recovery wells on January 30, 1985.

A summary of significant events related to the 1981 spill response and cleanup is presented in Table 3-1.

3.2 1986 SPILL AND RELATED REMEDIAL WORK

Approximately 400,000 gallons of paradichlorobenzene (DCB) and 169,000 gallons of trichlorobenzene (TCB) we at the Standard Chlorine of Delaware, Inc. pl

TABLE 3-1

SUMMARY OF SIGNIFICANT EVENTS CONCERNING
16 SEPTEMBER 1981 SPILL RESPONSE AND CLEANUP

16 September 1981	- Spill of industrial grade monochlorobenzene (MCB) occurred during filling of a tank car.
Spill Response Action	- Earthen dams and pumps installed by Standard Chlorine, to control and recover most surface runoff of spilled material prior to discharge to Red Lion Creek.
	- Subsequent surface soil sampling conducted by SCD in the drainage ditch indicated that most of the material from the ditch was recovered.
	- MCB contaminated soils removed from surface runoff ditch by SCD, under supervision of the Department of Natural Resources and Environmental Control (DNREC). Contaminated soils disposed of at a permitted off-site facility under RCRA manifest, by CECOS International.
	- Subsurface (soil boring) test program, conducted by SCD, indicated presence of MCB at depths as great as 40 feet in the vicinity of the spill Sampling consisted of 7 borings in the vicinity of the spill, with samples collected at 4-5 foot depth intervals (52 samples).
	- SCD retained Roy F. Weston, Inc. (WESTON) to conduct groundwater investigation and to evaluate potential remedial actions.
25 June 1982	- Field investigation study of potential groundwater contamination completed by Roy F. Weston, Inc. The first phase included installation of 10 groundwater monitoring wells on the SCD plant site. Groundwater depth and water quality

determined for each well. Each well except one was sampled at 4 depths, for a total of 39 samples. Seven sample splits were provided to DNREC for analysis in State Laboratory. Monitor well borings were sampled for stratigraphic control. In addition, a pump test was conducted on one well to determine drawdown characteristics and contaminant migration. Water samples were collected throughout the pump test for chemical analysis. General results of this investigation included:

1. Ground water flows generally northwest through the plant site.
2. MCB appeared to be sinking as a relatively well defined slug through the ground.
3. Local stratigraphy confirmed the presence of a clay layer which would serve to confine MCB and protect the Potomac Aquifer.
4. Recovery pumping would be feasible for effecting groundwater cleanup.

29 July 1983 - Additional field investigation, initiated by SCD upon request from DNREC, was completed by WESTON. Field work included exploratory drilling to determine the presence and continuity of subsurface strata, and construction of new monitor wells in areas of the plant not previously covered as well as off-site locations. Visual inspection of the area surrounding CB1 indicated that no further leakage was occurring. The final program encompassed 21 exploratory borings on or near SCD property and 10 new monitoring wells. All 20 wells were sampled and analyzed for various benzene species. The results of these analyses indicated that the railhead loading facility was the principal source area for groundwater contamination and that the plume was migrating in a generally northerly direction. Water level monitoring in all 20 (Phase I and Phase II) wells also

indicated that groundwater flow in the area was generally in a northerly direction; and that this flow was exerting the major influence upon contaminant migration. This study also recommended the use of groundwater recovery for contaminant plume control, with air stripping as the treatment method of choice for the contaminated groundwater. These results were discussed in the WESTON Report, "Hydrogeologic and Concept Engineering Evaluation of Groundwater Contamination", which was reviewed and approved by DNREC.

14 September 1983 - The study, "An Assessment of the Ambient Air Quality Impact of the Controlled Air Emissions from Standard Chlorine's proposed Air Stripping Tower" was completed by WESTON, indicating that the air discharge from the stripper could be routed to the boiler without adversely affecting the quality of the boiler stack gas.

September 1984 - The "Feasibility Study and Final Design Report, Standard Chlorine of Delaware, Inc." for the recommended groundwater treatment system was completed by WESTON.

18 December 1984 - Emergency construction permit for treatment plant modifications issued by DRBC.

21 January 1985 - NPDES permit for treatment plant modifications and increased flow issued by DNREC.

30 January 1985 - Withdrawal permits for recovery wells issued by DRBC and DNREC.

1985 - Groundwater recovery and treatment system constructed by SCD.

January 1986. The spill occurred after a 375,000-gallon tank of heated DCB split open, collapsed, and damaged three nearby tanks containing DCB and TCB, causing the latter tanks to partially spill. The initial tank failure was blamed on weak tank welds.

Since the products had been contained in heated tanks, at the time of the spill both products were in liquid form. However, due to cold outside temperatures (15-20°F), the products tended to freeze upon contacting the ground surface. This freezing helped to minimize the spreading of the spill in two ways:

1. It limited lateral spread of the DCB and TCB, as the ground-contacting "layer" solidified. However, the floating liquid "layer" flowed until it, too, contacted the ground surface and froze.

2. It limited vertical spread of the DCB and TCB into the ground surface as the ground was frozen. This limited penetration also facilitated an expeditious surface cleanup of solidified, pure product especially in the plant area.

The spilled products followed two pathways of flow, one easterly, onto asphalted plant property and one northerly, along the railroad tracks (see Figure 3-5). The flow onto the plant property was primarily contained on asphalted areas, where most of it froze, with the exception of a minimal amount which flowed to a drainage ditch along the eastern plant boundary. This material flowed northerly, along the ditch for a short distance, but dissipated before it reached the plant boundary. The spilled products which flowed along the railroad tracks continued down a steep drainage ditch to a small, unnamed tributary to Red Lion Creek (Figures 3-4 and 3-5). Approximately 100 yards downstream from the point where the fraction of the spill which had not yet frozen entered the tributary, it spread across the tributary channel and continued downstream to the area of confluence with Red Lion Creek. At the time of the spill, Red Lion Creek was at high tide ebbing; consequently, some of the spilled material fanned out from the mouth of the tributary and traveled approximately 500 feet upstream, hugging the southern shoreline. Both compounds are heavier than water, and consequently, both sank to the bottom. After cooling, the compounds stratified. The DCB formed a hard, flat, crystalline formation, and the TCB remained as a dense liquid lying immediately above and below the DCB.

Standard Chlorine of Delaware (SCD) took the immediate action in response to this spill:

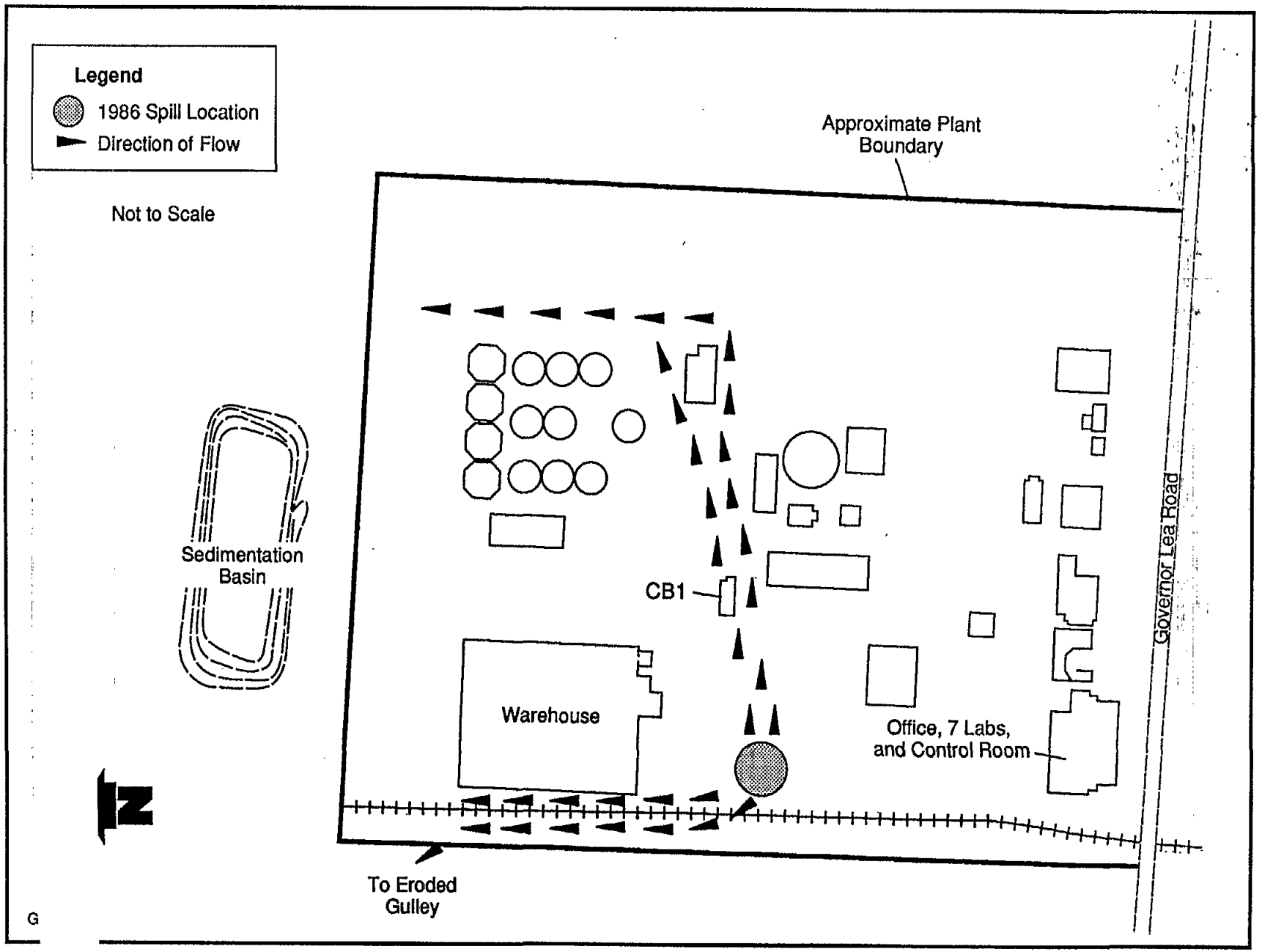
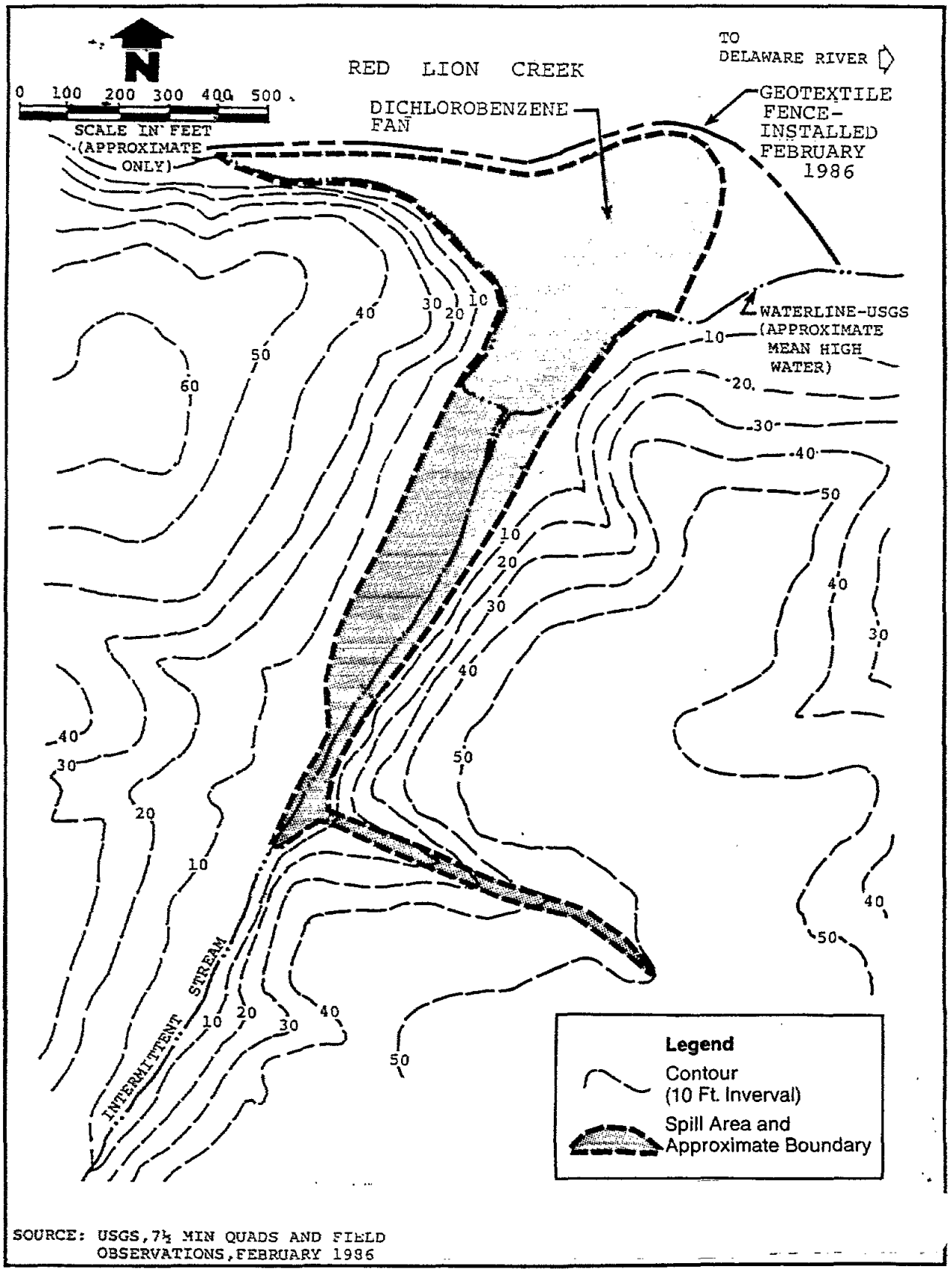


FIGURE 3-4 APPROXIMATE 1986 SPILL PATHWAY
STANDARD CHLORINE OF DELAWARE, INC.



SOURCE: USGS, 7½ MIN QUADS AND FIELD OBSERVATIONS, FEBRUARY 1986

FIGURE 3-5 DOWNSLOPE OF 1986 SPILL

AR300408

- SCD took prompt action to contain the spill in order to prevent further discharge into Red Lion Creek; preventative measures included booms and dikes, and a filter fence.

- To the extent possible, SCD recovered spilled material and reprocessed it for further use. A containment area was constructed on-site for storage of recovered material.

- SCD recovered (both) material which was still present on-site and, as much as possible, material which had flowed off-site.

SCD contracted WESTON Services, Inc. (WSI), a wholly owned subsidiary of WESTON, to provide technical/remedial services in the investigation of this incident. A complete description of the investigative and corrective actions conducted in response to the 1986 spill is provided in the 22 April 1988 WESTON report, "Report on Response and Cleanup Efforts of a 5 January 1986 Chlorobenzene Spill". A summary of significant events related to the 1986 spill is presented in Table 3-2.

3.3 OTHER SPILLS/RELEASES

Notifications of other spills/releases have been filed by SCD with DNREC, however these spills/releases are not highlighted as the focus of the RI/FS. In general, these spills/releases were small quantity (a majority were less than 100 pound) product spills or air releases, for which response measures were taken, as appropriate. Due to the nature of the product spilled (e.g. acids), the transient nature of a minor air releases, the small quantity spilled, and the response taken, these spills/releases are not expected to impact public health and/or the environment. Therefore, no signficant investigations have been conducted toward characterizing the nature and extent of these spills/releases, as has been done for the 1981 and 1986 spills and the leaking of CB1.

TABLE 3-2

SUMMARY OF SIGNIFICANT EVENTS CONCERNING
5 JANUARY 1986 SPILL RESPONSE AND CLEANUP

5 January 1986	- Spill of paradichlorobenzene (DCB) and trichlorobenzene (TCB) occurred as a result of a single tank rupture, the contents of which caused spillage from three nearby tanks.
Immediate Spill Response Actions	- Regulatory agencies, including the Department of Natural Resources and Environmental Control (DNREC), the National Response Center (NRC), and the Coast Guard, and emergency spill response subcontractors notified by SCD.
	- Dikes and booms constructed to contain the spill from further migration into Red Lion Creek.
	- Plant personnel and subcontractors collected material spilled on-site and placed the material in the containment area for future reprocessing/reuse.
	- SCD directed WESTON to conduct limited test pit study to determine the extent of vertical contamination. No vertical contamination was found probably due to the fact that the ground was frozen, thereby minimizing penetration.
	- SCD directed Guardian Construction company to remove the heaviest concentrations of DCB from along the banks of the unnamed tributary. This material was melted and reprocessed in the plant.
	- SCD directed Dover Steel to remove any damaged equipment on-site.

Following the completion of the immediate spill response actions, the following activities occurred:

13-14 January 1986- Water and sediment sampli

	bathymetric mapping of Red Lion Creek is conducted by WESTON. The sampling was repeated on 22 January 1986.
29 January 1986	- Ecological investigation initiated.
5 February 1986	- Construction of a filter fence was begun along the mouth of the wetlands cove and downstream of any apparent DCB/TCB crystals to minimize transport of contaminated sediments.
12 February 1986	- Soil samples collected from the wetlands area for chlorobenzene analysis.
4 March 1986	- Construction commenced of an earthen dike across the unnamed tributary to isolate upper portions of the wetlands from tidally influenced lower portions.
11 March 1986	- Excavation of contaminated sediments upstream of the dike and storage of these sediments in an area of the adjacent hillside was initiated.
15 March - 12 April 1986	- Construction of double-lined HDPE sedimentation basin for storage of recovered, contaminated sediments.
16 April 1986	- Downstream of the dike (between the dike and the filter fence) contaminated sediment dredging was begun. The sediment was pumped to a double-lined sedimentation basin; the aqueous phase was pumped to the air stripper for treatment on-site.
Environmental Monitoring	- Throughout the period of remediation, surface water, sediment, soil, and biota sampling was conducted to monitor site status and to measure the progress of remedial measures. The growth of wetlands vegetation has also been visually monitored since the time remedial activities were initiated.

SECTION 4

SITE STATUS

4.1 CONCEPTUAL SITE MODEL

Based upon the site background information provided in the first three sections of this report, a conceptual model of the site has been developed which illustrates the potential contaminant sources and potential migration pathways.

4.1.1 Potential Contaminant Sources

The 1981 and 1986 spills at Standard Chlorine of Delaware (SCD) were the primary sources of chlorinated benzene contamination at the site. The leaking of Catch Basin #1, which was discovered and remediated in 1976, was a secondary source of chlorinated benzene contamination. Both these primary and secondary sources are discussed here in an effort to identify the areas/media which should be investigated by the RI as potential continuing sources of contamination.

Reports of the 1981 spill did indicate ground water contamination as a result of monochlorobenzene (MCB) penetrating the site soils. Therefore, depending upon the MCB-retentive capacity of the soil, the soil may be interpreted as a potential continuing source of contamination.

Reports of the 1986 spill did not indicate ground water contamination as a result of paradichlorobenzene (DCB) and trichlorobenzene (TCB) penetrating the site soils; however, they did indicate that the site soils themselves were contaminated by these compounds. Therefore, as part of the corrective actions any known-contaminated, recoverable soils and sediments were removed by excavation and dredging. Depending upon the effectiveness/completeness of the recovery operations, residual contamination may still exists in remaining soils and sediments. As a result, the soils and sediments still in-place must be considered as a potential continuing source of contamination.

Corrective actions taken in response to the 1986 spill also resulted in the storage of contaminated sediments into two areas off-site: soil piles and a sedimentation basin. Both storage areas are lined, although, the liners fo
piles have degraded over time, allowing the pot
release of contamination. Both storage areas
examined as a potential continuing source of contamination.

Reports of the discovery/remediation of the leaking Catch Basin #1 (CB1) indicate that CB1 was excavated and replaced, along with a portion of the underground line discharging into it. However, ground water sampling conducted in response to the 1981 MCB spill indicated the presence of other chlorinated benzene products, attributed to the leaking of CB1. Although the routine annual inspections of soil surrounding CB1 have not indicated contamination (by digging and visual inspection), the soil cannot be ruled out as a potential continuing source of contamination.

In summary, then, based on the conceptual site model, the following potential continuing sources of contamination will be investigated during the RI:

- Soil from the pathway of the 1981 spill.
- Soil and sediments from the pathway of the 1986 spill.
- Excavated soil and sediments recovered in response to the 1986 spill.
- Soil surrounding CB1.
- Ground water potentially discharging into surface water adjacent to the facility.

4.1.2 Potential Migration Pathways

Ground water, surface water, and sediments will be characterized as potential contaminant migration pathways in the areas of both spills and Catch Basin #1.

Ground water downgradient of the spill areas and CB1 will be characterized as a potential migration pathway. Contaminated ground water was indicated resulting from the 1981 spill, thereby confirming the necessity for further characterization.

Surface water, particularly in the wetlands and Red Lion Creek, is a potential migration pathway downgradient of the spill areas. Elevated surface water contamination resulted from the 1986 spill, as evidenced by the harmful effects to fish in the tributary to Red Lion Creek. Therefore, surface water will be examined as a potential contaminant migration pathway. Biota will be examined as potential contaminant receptors.

Sediments of the drainage ditches, wetlands, and Red Lion Creek will be examined as both potential continuing sources and as potential migration pathways. (Consideration of sediments as potential continuing sources was discussed in the previous subsection.) Contaminated sediments from the western drainage ditch flow pathway of the 1986 spill were removed during the cleanup actions, however, the extent of any further contamination has not been established. The potential for existence of contaminated sediments from the eastern flow pathway is not anticipated, with the exception of the eastern boundary drainage ditch. As stated earlier, the flow onto plant property was over asphalt paving, and, considering the very cold temperatures and scraping up of free product which was done, penetration was unlikely. Characterization of the remaining sediments as potential migration pathways will serve both to verify the effectiveness of the cleanup action and to examine potential contaminant migration in the remediated areas.

Other than personnel protective monitoring, air will not be investigated as a potential migration pathway during the RI for the following reasons:

- The primary and secondary sources of contamination (the spills and leaking CB1) occurred over three years ago and could, therefore, not conceivably be emitting contamination to the air.

- The soils and sediments being investigated as potential continuing sources are not considered to be releasing air emissions due to vegetative and/or asphalt cover, now present in each of the areas.

- SCD is an operating facility which has permitted air emissions, therefore the investigation of this pathway would likely confuse low-level, permitted emissions from the current operations as contamination from the past spills.

- Effluent gases from the ground water treatment air stripper are not vented to the atmosphere but, rather, are vented to the existing process boiler, thus eliminating air as a potential migration pathway from the unit. This venting of effluent gases to the boiler was one recommendation proposed by the WESTON 1983 assessment of ambient air quality impacts from the proposed stripping tower.

The 1987 DNREC study on chlorinated benezene emissions from SCD included the sampling of ambient air both at the fenceline and in the nearest residential area, i.e., Delaware City, and the study of plant processes as potential emission sources. The ambient air data collected indicated that chlorinated benzene levels at the SCD fenceline were below the standards established for a work environment by more then two orders of magnitude. The report concluded that, although SCD contributes chlorinated benzenes to the atmosphere, the emissions are at an acceptable level and do not merit evaluating additional control technology. For these reasons air is not being investigated as a potential migration pathway. In the unlikely event that the personnel protective monitoring indicates the presence of volatile organics above action levels, a program of air sampling will be considered.

In summary, the following potential migration pathways will be investigated during the RI, based on the analysis of the conceptual site model:

- Ground water,
- Surface water,
- Sediments and soils,
- Air (personnel protection only).

4.1.3 Potential Contaminant Receptors

Based on the potential migration pathways, potential contaminant receptors can be identified. For the ground water pathway, at this juncture, no known receptors of the Columbia aquifer exist; potential receptors of the Potomac aquifer will be identified as part of the RI data collection activities (see Section 5). For surface water, the potential receptors include biota (especially fish) inhabiting the unnamed tributary or Red Lion Creek. For sediments, soils, and air, the only potential exposure could be via direct contact by SCD personnel working on-site. The potential receptors will be examined in detail in the endangerment assessment.

4.1.4 Review of the Conceptual Site Model

Review of the conceptual site model provides the basis for determining the actions required to complete an RI/FS at the site (see Figure 4-1). In particular, knowledge of the potential continuing sources and potential migration pathways permits the following activities:

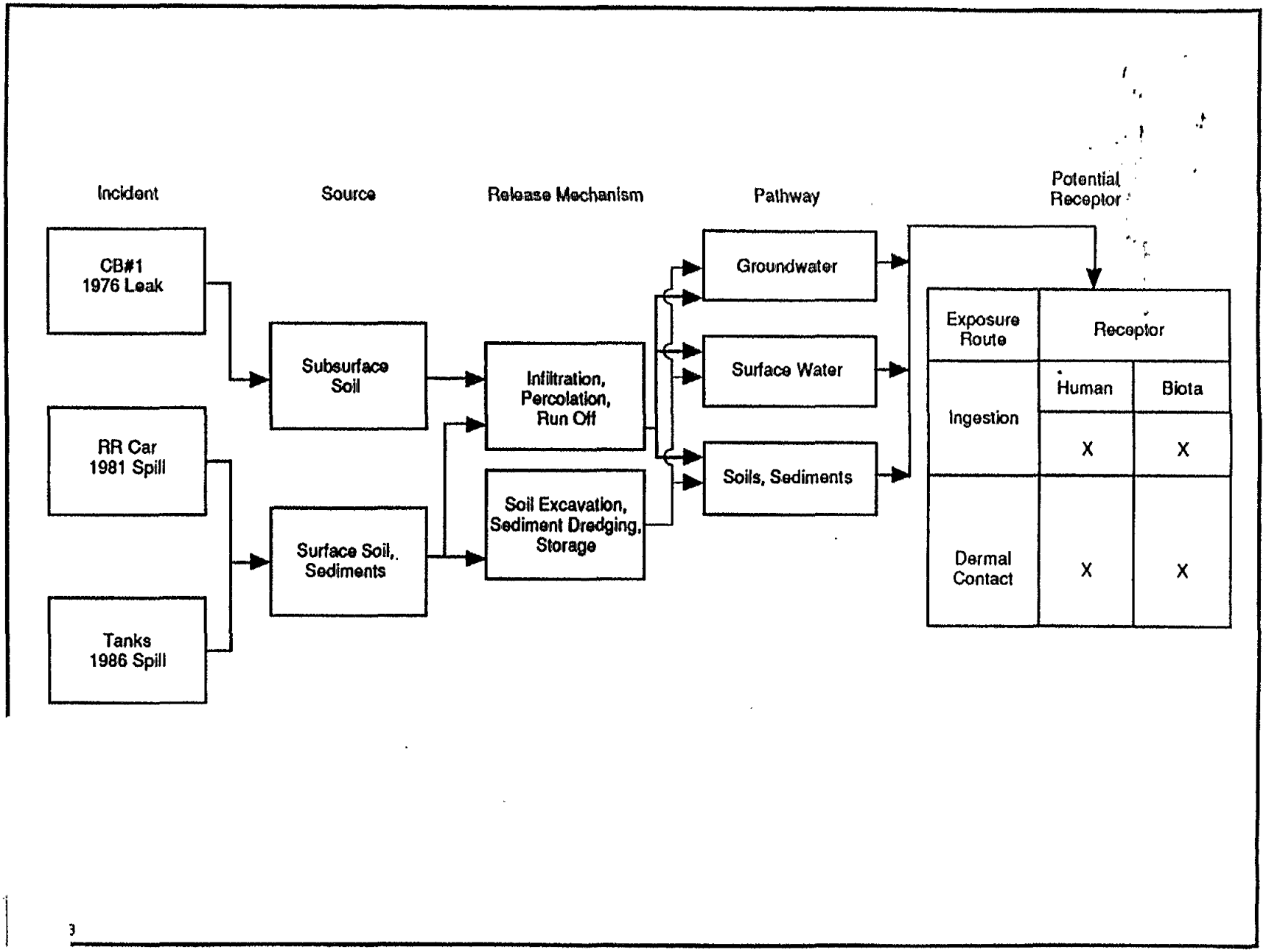


FIGURE 4-1 SCD CONCEPTUAL SITE MODEL

- identification of applicable remedial technologies (based on the preliminary background information), and, subsequently,

- identification of the data requirements which exist for implementation of the identified technologies and completion of the RI/FS at the site.

The remainder of this section describes those activities. Section 5 describes the data collection activities, which will be performed to satisfy the data requirements identified here.

4.2 IDENTIFICATION OF REMEDIAL TECHNOLOGIES

Once the conceptual site model has been developed, remedial technologies can be identified. It is advantageous for this identification to be done during this work plan phase of the RI/FS so that the data necessary to support the use of particular technologies can be planned for collection during the RI. This identification of technologies is a first step in the FS development of remedial action alternatives, to be followed by the technology screening (see Section 6.0). The technology screening will be conducted following the RI collection/analysis of data to satisfy the data requirements which would prevent an optimal, accurate screening of technologies.

According to the Environmental Protection Agency (EPA) Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (August 1988), the identification of remedial action objectives and the identification of general response actions to fulfill those objectives are the first two general steps in the FS process. (These two steps lead directly to the identification of technologies, as shown below).

The remedial action objectives for SCD were eluded to by the conceptual site model, but were not directly stated as part of the site status (subsection 4.1). The model did indicate that the site concern is potential chlorobenzene and/or nitrobenzene contamination of soil, ground water, surface water, and sediment. The potential exposure pathways, which have not yet been discussed, include biota (fish) and ground water (should any receptors be identified). The objectives of remedial actions at SCD, then, are to remediate contaminated media to the extent that receptors are no longer at risk; i.e., to satisfy the applicable or relevant and appropriate requirements (ARARs) and to be c

(TBC) guidelines. These ARARs include, but are not limited to, the EPA Drinking Water Standards and Ambient Water Quality Criteria and Delaware's Water Quality Standards for Streams and State Regulations Governing the Control of Water pollution. Based upon the nature of the remedial technoogy, RCRA guidelines and the existing SCD NPDES efluent limits may also be applied. ARARs will be referenced again in Section 6 and will be further developed in the Endangerment Assessment according to the data collected during the RI.

The general response actions appropriate for use at SCD are outlined in Table 4-1. All actions will be considered in light of the remedial action objectives for SCD, however some of the actions have already been implemented (either fully or partially). Those general response actions which have already been implemented are footnoted in the table. The no action response is included as the baseline for comparison with the active responses. Table 4-2 identifies the technologies which will be evaluated for each general response action. These technologies will be screened and developed into remedial action alternatives which, in turn, will be evaluated in detail in Section 6.

4.3 IDENTIFICATION OF DATA REQUIREMENTS

Development of the conceptual site model indicated the data requirements which are necessary for the evaluation and implementation of the remedial action technologies. Therefore, the need for additional data has been identified for the following media:

- Soil
- Ground Water
- Surface Water
- Sediment

Also, the soil piles and the sediment storage basin, both of which were "formed" as a result of excavating contaminated sediments, require additional data collection according to their identification as potential sources by the conceptual model above.

4.3.1 Soils Data Requirements

In general, only one set of limited soils data is available; that data was collected following the 1981 spill incident. The soils data collected following the 1981 spill was obtained via seven soil borings sampled at five foot intervals to a depth of 40 feet. Although these data did-

TABLE 4-1

GENERAL RESPONSE ACTIONS FOR SCD

1. No Action
2. Containment*
3. Diversion*
4. Collection*
5. On-site Treatment*
6. On-site Disposal*
7. Removal (partial/complete)*
8. Storage*
9. Pumping*
10. Off-site Disposal*
11. Off-site Treatment
12. In-situ Treatment

* Indicates general response actions which have already been implemented.

Please Note:

The disposal of contaminated sediments in the dirt piles and in the sedimentation basin will be considered as "on-site" although both areas are outside of the plant boundaries.

TABLE 4-2

TECHNOLOGIES FOR CONSIDERATION AT SCD

General Response Action	Associated Technologies
1. No Action	o Periodic Monitoring/Analysis
2. Containment	o Soil Covers o Synthetic Membrane Caps o Low Permeability Soil Caps o Asphalt/Concrete Caps o Ground Water Barriers
3. Diversion	o Grading o Dikes, Berms, Swales
4. Collection	o Sedimentation Basins, Ponds
5. On-Site Treatment	o Incineration, Low Temperture, Thermal Treatment, Extraction o Wastewater Treatment Facility
6. On-Site Disposal	o Secure Landfill
7. Removal	o Excavation o Dredging
8. Storage	o Permitted Storage Pad
9. Pumping	o Extraction Wells o Surface Pumps
10. Off-Site Disposal	o Secure Landfill
11. Off-Site Treatment	o Soil Treatment Technologies as listed for on-site treatment.
12. In-Situ Treatment	o Soil Washing o Vitrification/Steam Extraction o Biodegradation

tend to indicate a higher level of contamination in the immediate spill vicinity, the data were not validated following collection.

Following the 1986 spill incident, sediment data, but not soils data, was collected at various stages throughout the response cleanup. Since the ground was frozen during the time of the 1986 spill, spilled products could not infiltrate the ground surface and, therefore soil samples for chemical analysis were not collected. To verify that infiltration had not occurred, test pits were excavated with backhoe. SCD, WESTON, and DNREC personnel, who were present at the time, observed that spilled product infiltration had not occurred. Nonetheless, in order to complete a current model of the site, post clean-up soil data is required from the immediate vicinity of the spill and just downslope of the spill area.

Following the 1976 remediation of the leaking Catch Basin #1 (CB1), soil samples for chemical analysis have not been collected. Annual monitoring of the surrounding area has been done via digging and observations, which have indicated that the remediation was effective. However, post clean-up soils data is required from the immediate vicinity of CB1.

Soil data requirements exist, then, due to the lack of quality assurance on the few samples which were collected following the 1981 spill and due to a lack of post data cleanup following the 1986 spill and following the CB1 remediation. These data are necessary for establishing whether soils are indeed a potential continuing source and, if so, for determining the appropriate remedial technologies.

The RI activities proposed to satisfy these data requirements are outlined in Section 5.

4.3.2 Ground Water

On-going hydrogeologic investigations following the accidental release of chlorinated benzene products in 1981 have yielded a substantial body of data for characterizing the magnitude and extent of ground water contamination and ground water flow conditions at the SCD facility. A summary of major findings is given below, followed by the data requirements to be satisfied during the RI to support the existing ground water quality and flow data.

4.3.2.1 Background

Following the 1981 monochlorobenzene (MCB) sp
facility, WESTON installed 10 monitoring wel
SCD property boundary (see Figure 4-2). Analysis of ground

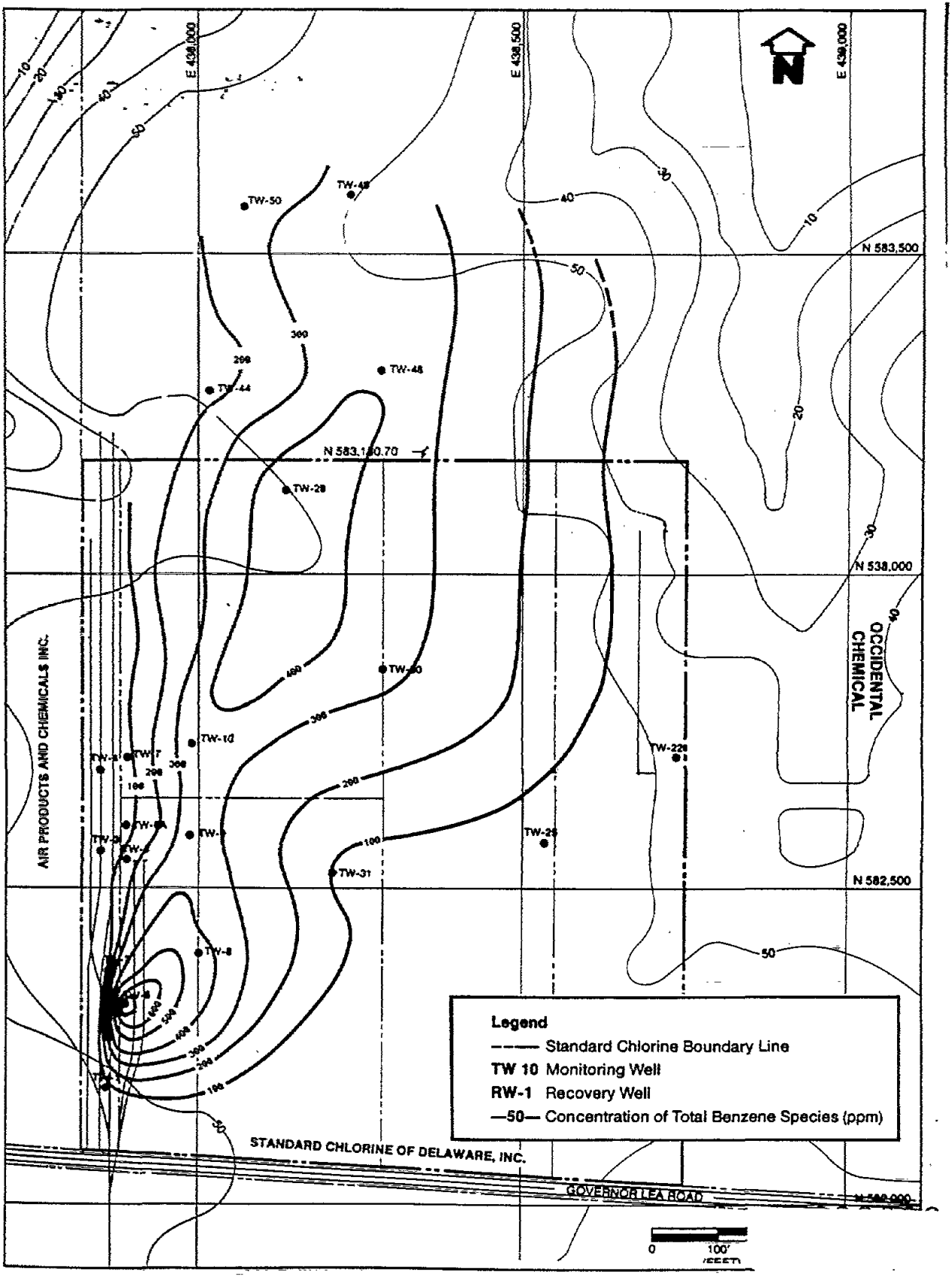


FIGURE 4-2 ISOCONCENTRATION MAP OF TOTAL BENZENE SPECIES DECEMBER 1982

AR300422

water samples collected from these wells indicated the presence of MCB contamination in the ground water of the Columbia aquifer. As part of a subsequent 1983 investigation, WESTON installed 10 additional monitoring wells within and to the north of the SCD facility. Water level measurements taken from these additional wells confirmed the general northerly direction of ground water flow off-site. Chemical analyses of ground water samples collected from these wells indicated that migration of the MCB had occurred.

The feasibility of pumping and treating ground water was investigated during the 1983 study. A 37 gpm, 72-hour pump test was conducted on monitor well TW-6A, the results of which indicated that a fairly extensive cone of depression in the area of the MCB spill had been created. Therefore, pumping and treating ground water at the facility was deemed a feasible concept. The concept was presented to the DNREC and was approved in-principle.

Recovery wells RW-1 through RW-4 were installed and the construction of an air-stripper treatment system was initiated in January of 1985. The wells were not put into service immediately due to the regulatory delay created by the site becoming listed on the NPL. During the initial pumping period, early-mid summer 1986, it was observed that the wells would sustain pumping at rates of 10 to 15 gpm, rather than the assumed rates of 40 gpm. This reduction in pumping rates is due to apparent gradational increases in the percentage of finer grained materials, with a resulting decline in the local transmissivity of the Columbia aquifer near the recovery wells.

The hydrodynamic barrier created by the ground water recovery system has resulted in a progressive reduction in ground water contaminant concentrations as shown in Figure 4-2 and 4-3 which show the total benzene species isoconcentration maps for December 1982 and December 1988 respectively.

4.3.2.2 Ground Water Data Requirements

Based on the background information provided above, and the data collected from monthly monitoring of the ground water recovery and treatment system, the remaining data needs were assessed. In particular, further investigation is required to accurately determine the effect of the hydrodynamic barrier and to precisely define the capture zone created.

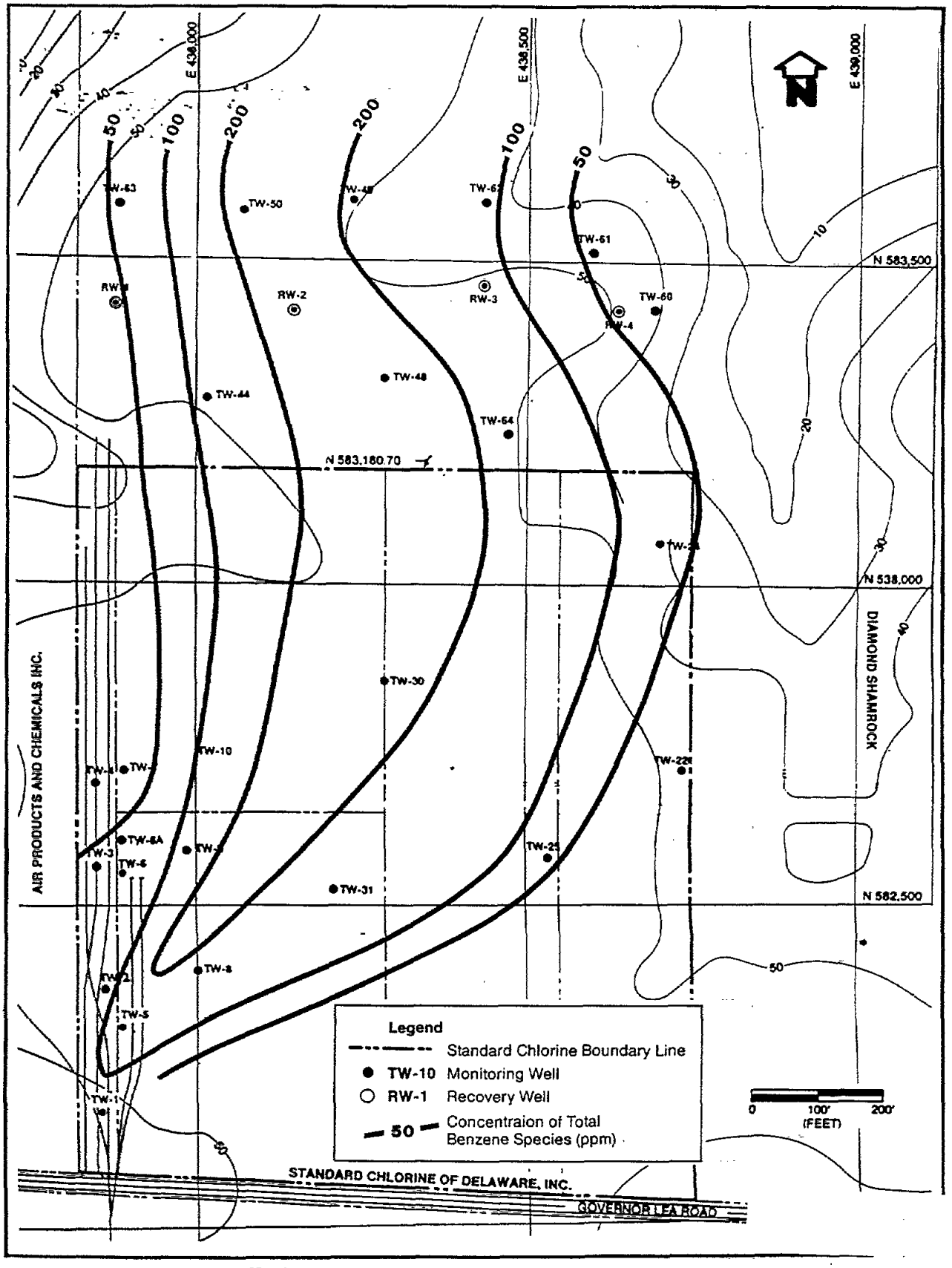


FIGURE 4-3 ISOCONCENTRATION MAP OF TOTAL BENZENE SPECIES 2 DECEMBER 1988

AR300424

The extent of the contaminant plume in the ground water must be defined, particularly along the northern boundary of the site. The relationship between ground water in the Columbia aquifer and surface waters of Red Lion Creek and the unnamed tributary must also be determined. In addition, water quality conditions and flow directions in the upper Potomac aquifer should be assessed to determine the potential for contamination of the upper Potomac aquifer.

The RI activities proposed to fill these data requirements are outlined in Section 5.

4.3.3 Surface Water/Sediments in Red Lion Creek

Three series of surface water/sediment samples were collected from Red Lion Creek following the 1986 spill incident. The first series was collected in the apparent attempt to monitor the surface water quality shortly after the spill occurrence (mid-late January and early March 1986). The samples were collected from 15 locations and indicated relatively stable levels of total chlorobenzenes in the surface water ranging from below 0.05 mg/l to 3 mg/l. The sediment data was less consistent, with elevated levels noted at one to two locations of each sampling round.

The second series of surface water/sediment samples were collected to illustrate the effectiveness of dredging the area near the confluence of the tributary with Red Lion Creek. These samples were collected during May of 1986 but proved inconclusive due to several factors:

- Judging by the location designations, it appears the samples were collected from different locations during the two events.

- Inconsistently high levels of total chlorobenzenes were noted in several of the samples analyzed, particularly in surface water samples (two orders of magnitude difference) raising the suspicion that some suspended solids were probably collected with the aqueous sample. The levels in surface water ranged from 2.32 mg/l to 2840 mg/l, with a mean of 5.99 mg/l.

The third series of surface water/sediment samples were collected on March 31, 1988 at six locations within the wetlands area. The level of total chlorobenzenes ranged widely in the surface water samples and showed levels between .0045 and 1.666 mg/l.Results of the analysis of the sediment samples are presented in the following 4.3.4.

Based on the limited amount of recent data, further surface water sampling is recommended in Red Lion Creek and its unnamed tributary, according to the outline given in Section 5.

The Red Lion Creek and wetlands surface water samples described in this section 4.3.3 were, for the most part, accompanied by sediment samples. An assessment of the remaining sediment data from the wetlands area and identification of data requirements to fulfill the RI/FS objectives are presented in the following subsection.

4.3.4 Sediments

The scope of the sediments investigation covers the area within the wetlands on either side of the unnamed tributary to Red Lion Creek. The sediments in Red Lion Creek are associated with the previous section relating to the surface water data. The sediments in the wetland area along the tributary were affected by the 1986 product spill and subsequent clean up, which involved dredging and removal of product and contaminated sediments. At the time of the spill incident, the majority of this area was affected by tidal action and partially or totally covered by water, pending tidal occurrences. Currently the area is not affected by tides due to the repair of the tide gate along Red Lion Creek and, therefore, is no longer affected by tidal surface waters.

The primary database relating to the sediments in this wetland area is contained within the WESTON report entitled "Report on Response and Cleanup Efforts of a 1986 Chlorobenzene Spill," 22 April 1988. The initial sediment sampling in this wetlands area occurred on 13 and 14 January 1986, approximately one week after the spill incident. The majority of these initial sediment samples were collected along Red Lion Creek, however several were in the vicinity of the confluence of the tributary with Red Lion Creek. The total chlorobenzene concentrations ranged from below the detection limit to 4,061 mg/kg, which was demonstrated by the only sample above 15 mg/kg. A follow-up round of sediment sampling along Red Lion Creek occurred on 22 January 1986, again an immediate response to the 1986 spill. Several of these samples were collected near the confluence of the tributary with Red Lion Creek. These sediment sample data were used to map the location of the spilled product material along the creek and to guide the clean up effort. These samples exhibited total chlorobenzene concentrations ranging from below the detection limit to 6200 mg/kg with the mean value being 0.87 mg/kg.

Additional sediment sampling was performed on 12 February 1986, when fourteen sediment samples from the wetlands area were collected for chlorobenzene analyses. This wetlands sampling area extended from the discharge of the eroded gulley into the tributary down to the confluence of the tributary with Red Lion Creek. These sediment samples were collected at a depth of between 6 to 12 inches below the surface of the sediment. The chlorobenzene data indicated that the highest concentrations, exceeding 1000 mg/kg, were found adjacent to the unnamed tributary stream channel and the lowest concentrations, near or less than the detection limit of 0.05 mg/kg, were found along the wetland edges. This sediment sampling work again was conducted prior to the dredging and clean up work, which subsequently followed.

Prior to initiating the clean up of the spilled materials from the wetlands, another round of wetland sediment sampling was conducted on 11 and 13 March 1986. Samples were taken from three soil profiles: 0 to 6 inches, 6 to 12 inches, and 12 to 18 inches. It was found that there was significant decrease in chlorobenzene concentrations between the 0 to 6 inch sample, which ranged from <1 mg/kg to percent concentrations, and the majority of the deeper sediment samples collected, which ranged from <1 to 490 mg/kg. A total of 22 locations were sampled at these three depths during this round of sample activities. The removal work that began and the excavation strategy involved removing the first 6 inches of material which included sediments and crystallized chlorobenzene crust from the wetlands. It was estimated that between 2,000 and 3,000 cubic yards of material were recovered from the wetlands area and placed in temporary staging.

Following this removal, a total of 35 sediment samples were collected in the wetlands area for chlorobenzene analyses. Soil samples were collected from 0 to 6 inches below ground surface and showed significant decrease in total chlorobenzenes. The majority of the sample concentrations ranged from 3.3 to 23.1 mg/kg total chlorobenzenes; the total of the sample concentrations ranged from 3.3 to 123.1 mg/kg.

While extensive sediment sampling was conducted prior to the spill clean up work and immediately following the work, the purpose of this sampling and analyses was primarily to guide the clean up activities. To meet this objective, the samples were collected and analyzed to provide rapid turnaround results. Data validation was not pe[illegible] on this work, however it should be recognized as vi[illegible] to the RI/FS.

The only additional sediment sampling which has occurred in the wetlands area following the remediation activities was performed in March 1988. At this time the tide gate had been repaired and the area was no longer affected by tidal waters and consisted of wetland/marsh areas. A total of 15 sediment samples were collected on 31 March 1988 in this area. This sampling followed detailed protocol for sample location, sample collection, decontamination procedures and blank and duplicate sample collections. The sediment samples were collected at a depth of approximately 6 to 10 inches below ground surface and were analyzed in the SCD analytical laboratory. The sediment samples collected from the dredged and scraped area within the wetlands showed varying concentrations of total cholorobenzenes, the highest being 1,104 mg/kg and the lowest being 1 mg/kg.

The most recent sampling conducted in March 1988 provides an initial data base and mapping of the chemical quality of the sediments remaining in the wetlands. Within the wetlands area, the total chlorobenzene concentrations ranged from <1 to 1100 ppm; in Red Lion Creek the concentrations ranged from 2.2 to 604 ppm. To complete the RI, additional sediment sampling should be performed to complete the characterization of the wetland area. In addition, field mapping should be conducted to visually locate the remaining pockets of product material in this area as part of the RI.

4.3.5 Soil Piles and Sediment Basin

As discussed previously in this work plan, the clean up activities associated with the 1986 spill, resulted in the need for soil/sediments to be removed from the wetlands and placed in a storage area. The drier sediments or soils scraped from the wetlands were staged in three staging areas located on the hillside to the east of the wetlands area (as shown in Figure 4-4). These staging areas were constructed of earthen berms and were lined with visqueen. The removed materials were placed in these staging areas in piles, which were then covered by visqueen. The objective of this staging area for soil/sediments was to provide temporary containment for these materials removed as part of the spill response activities. Samples have not been obtained from the materials in these staging areas, however, it is expected that chlorobenzene concentrations in these materials would be similar to the concentrations measured in the wetland sediments prior to excavation and removal. During the clean up activities, the material was removed from the wetlands and transported to these staging areas in discrete loads, and therefore it is expected that concentrations of chlorobenzenes within the soils/sediment mate

highly variable due to the way the material was removed from the wetlands and placed in the staging areas. The quantity of material in these staging areas has not been accurately determined, and this quantification will be included in the RI field mapping survey.

Over time the temporary containment of these staging piles has undergone weathering and some of the soil/sediment material has been exposed to precipitation and runoff. The runoff channels and ditches draining this area should be sampled to determine levels of chlorobenzene. Contaminated sediment/soils from the piles may have eroded into the drainage ditches and this potential contamination should be investigated. At this time, these drainage ditches have not been field located and, therefore, sampling locations will have to be field determined during the RI when the drainage ways are identified.

The sediments collected from the dredging wetlands area were placed in a sediment storage basin. The basin was designed and constructed utilizing a double liner with engineered containment berms. High density polyethylene (HDPE) with a membrane thickness of 60 ml was used as the liner material. Between the two liner systems is a detection zone with monitoring access. The chemical characteristics of the dredged sediments in the basin would be similar to the analytical results for sediment samples collected in the area where the dredged sediment was removed. It is probable that the chlorobenzene concentrations for these sediments range from below detection limits to pure product material, however no samples of sediments have been collected directly from the basin to confirm those variations.

The quantity of material in the basin was not measured during filling, however it can be determined based on the design dimensions used for basin construction. The topographic survey can be used to determine the elevation of the sediments in the basin and the quantity determined. An extensive sampling of these sediments would involve significant risk. The basin sediments are not easily accessible due to the high moisture content, water layer and minimal bearing strength of this material. Any deep sampling of the sediments would also risk a possible puncture of the bottom liner. It may also be expected that the chlorobenzene concentrations in the sediments within the basin would be highly heterogeneous due to their variability in the wetlands during dredging and variability attributable to placement in the basin. Nonetheless, a limited sampling program of these sediments will be undertaken, consisting of sampling the more easily accessible sediments near

Facilities Map

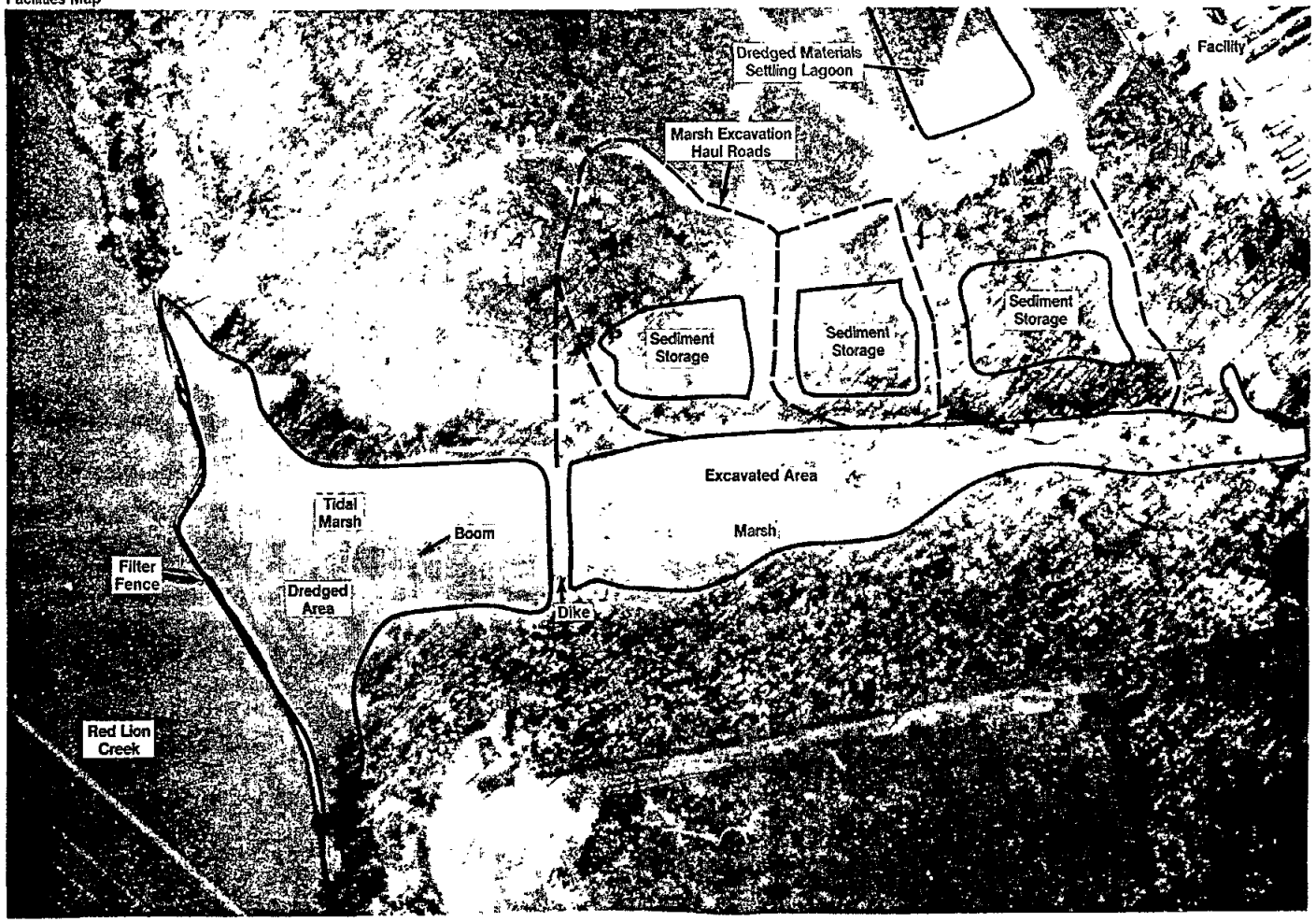


FIGURE 4-4 SOIL STAGING AREA

of the basin. Using this data, then, evaluation of FS alternatives will proceed also considering the knowledge of concentrations existing prior to dredging and knowledge that product material may exist in the basin.

The monitoring zone which exists between the liners should be sampled as a means for confirming the integrity of the liner system. This information will be important in assessing the integrity of this basin for providing storage of the material until the FS is completed. If the integrity of the liner system is found to be questionable, a focused and fast track FS may be desirable for this basin material to expedite final remediation. As a result, this sampling to confirm the integrity of the liner system will be planned early in the RI schedule, with priority, as explained in Section 5 and illustrated in Section 7.

4.4 RI/FS OBJECTIVES

This Remedial Investigation/Feasibility Study (RI/FS) at Standard Chlorine of Delaware (SCD) is being performed under a Consent Order signed by the Delaware Department of Natural Resources and Environmental Control (DNREC) on 14 November 1988. As required by the Consent Order, the RI/FS will be conducted in accordance with the requirements of the Comprehensive Environmental Response, Cleanup and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The overall objectives of the RI/FS at SCD are to complete a comprehensive investigation of the on-site and off-site contamination situation, and to evaluate and select remedial action alternatives. The specific objectives of the RI/FS are:

- To assess the extent of contamination in the soils;
- To assess the extent of contamination in the ground water;
- To assess the extent of contamination in the surface water and sediments of the wetlands, the unnamed tributary, and Red Lion Creek;
- To determine the magnitude and probability of actual or potential harm to public health, welfare or the environment (including biota);

- To develop and evaluate remedial alternatives, that will effectively cleanup or prevent further migration of contamination found in soil, ground water, surface water, and sediment;

- To recommend a remedial action that is technically and environmentally sound, and the most cost-effective.

These objectives are the basis of the Data Quality Objectes (DQO's) guiding the analytical program, as desecribed in the QAPjP.

SECTION 5

REMEDIAL INVESTIGATION

The following RI tasks have been developed in response to the Consent Order between the Delaware Department of Natural Resources and Environmental Control (DNREC) and SCD. Each task will address a specific area of concern to be investigated during the in-field activities at the facility. Data obtained as a result of the RI execution, along with existing data will provide the basis for evaluation of remedial alternatives for the site.

Due to the ambitious time frame for this project, this remedial investigation plan includes an outline of field protocols which are augmented in detail in the QAPjP, submitted along with this Work Plan. The QAPjP includes the requirements for proper field sampling protocols including a health and safety plan; a quality assurance project plan; and a data management plan. The QAPjP addresses the following subjects:

- Procedures for each field activity to be conducted at the site. Included in the plan are methods for drilling and well construction, development, and surveying; sample collection, handling, and preservation; and analytical protocols. All procedures are in accordance with USEPA approved practices and guidance.

- Health and safety protocols to be followed during execution of the field work. Included are emergency procedures, designation of work zones, health and safety equipment and decontamination procedures.

- Procedures to provide a common basis for the entry, storage, and access of project-related data. This will effectively aid in the acquisition and recording of data by providing standard data forms and easy-to-use data entry methods.

- Criteria for ensuring accuracy and precision for each parameter to be analyzed, calibration and maintenance of field monitoring equipment, as well as protocols for quality control samples, internal

checks system audits, data reduction, validation and reporting.

A summary of the sampling which will be conducted during the RI is presented in Table 5-1.

5.1 TOPOGRAPHIC MAP AND SURVEYING

An overflight of the SCD site and vicinity has been completed so that an accurate base map of the area can be developed. That flight occurred on 12 April 1989, after all snow cover had melted and before foliage had appeared to obscure land contours. The new topographic map, which is in production as of this writing, will include all areas of the site and vicinity that will be investigated in this RI. The contour interval of the topographic map will be 2 feet except in steep slope areas.

On-site surveying will be conducted to establish necessary site grid systems to be used in the field investigations. All sampling locations will be surveyed for vertical and horizontal control. In addition, the top of casing and ground surface elevations will be determined at each monitor well. The locations of the sampling points will be plotted on the new site topographic map.

5.2 SOILS

The sampling plan for the soils portion of the RI will focus on the drainage paths of the 1981 and 1986 spills and borings to be placed at various locations to confirm the extent of the Potomac clay layer and possible migration of contaminants into the clay matrix. Miscellaneous sampling will also be conducted near Catch Basin #1 (CB1) to confirm the effectiveness of remediation which has been done there. Figures 3-1 and 3-4 show the approximate locations of the 1981 and 1986 spills and the drainage pathways taken by the products, in addition to the location of CB1. A more detailed description of the soil borings is given in subsection 5.6, ground water investigation.

5.2.1 1981 Spill Pathway

The path taken by the product during the 1981 spill extended approximately 400 feet south of the spill area, then approximately 800 feet west down an eroded gulley toward the unnamed tributary of Red Lion Creek. Reports of the spill incident indicated that the product flow dissipated prior to reaching the tributary.

TABLE 5-1

RI SAMPLING PROGRAM SUMMARY
STANDARD CHLORINE OF DELAWARE, INC.

Sample Media	Sampling Location	Sampling Depths	Number of Chemical Samples
Soil	1981 Spill Flowpath	0-6", 12"-18"	32
	1986 Spill Flowpath	0-6", 12"-18"	56
Sediments	1986 Fp.-Wetlands	Dep. on headspace	Est. 50
	Basin Sediments	N/A	1
Soil	Soil Pile Runoff	0-6", 12"-18"	Est. 20
	Soil Piles	N/A	3
Soil Boring	Catch Basin #1	10', 20'	4
Groundwater	Monitor Wells	N/A	63
Surface Water	Red Lion Creek	N/A	7
	Tributary	N/A	3
Sediment	Red Lion Creek	N/A	15
Fish	Red Lion Creek	N/A	2 Zones
Aqueous	Basin Monitor Zone	N/A	2

Notes:

- The number of samples listed does not include duplicates.
- Field parameters to be recorded for aqueous samples include pH, specific conductance, dissolved oxygen, oxidation-reduction potential, salinity and temperature. Field parameters to be recorded for the wetlands sediment samples include pH, specific conductance, oxidation-reduction potentials, color, and temperature. In addition, HNu/OVA readings and field observations will be recorded for all media. Lithologic characteristics will be recorded for soil borings.
- Chemical analytes include benzene and chlorinated derivatives, and a TCL scan for duplicates.

Soil samples will be taken at 100 foot intervals along the drainage path of product flow (see Figure 5-1). The sampling will extend an additional 400 feet beyond the end of the gulley for cleanup confirmation purposes. At each location two soil samples, one at a depth between 0-6 inches below ground surface and another at a depth between 12-18 inches will be collected for chemical analyses in accordance with the QAPjP requirements. These two depths were selected based upon the analytical profile of wetlands sediment samples collected during March 1986 (see subsection 4.3.4). The 0-6 inch sample should be collected from native soil, but as near to the surface as possible to represent surface soil conditions. It is estimated that a total of 32 soil samples will be collected during this task: 2 samples at each of the 16 locations along the 1600 foot total flow path described above.

5.2.2 1986 Spill Pathway

Reports of the 1986 spill indicated that product flowed primarily in two directions: northerly along the railroad tracks and easterly toward the plant interior. The northerly path taken by the product during the 1986 spill extended approximately 800 feet north of the spill area, then approximately 800 feet west down an eroded gulley toward the unnamed tributary of Red Lion Creek. The easterly path extended across the plant property toward a small drainage ditch along the eastern boundary of the plant. Figure 3-4 illustrates the approximate direction of product flow from the 1986 spill. A majority of the product from the 1986 spill froze as it contacted the ground and was contained on the plant asphalt (later scraped for recovery), therefore limited sampling will occur along this easterly flow pattern (see Figure 5-2 for soil sampling locations).

Soil samples will be collected at depths of approximately 0-6 inches and 12-18 inches at each sampling location. Chemical analyses will be performed on all samples collected in accordance with QAPjP requirements.

Sampling Locations have been designated as follows:

- Northerly flow path:
  - 100 foot intervals along the railroad tracks (800 foot length) since the most complete product recovery was effected in this area.

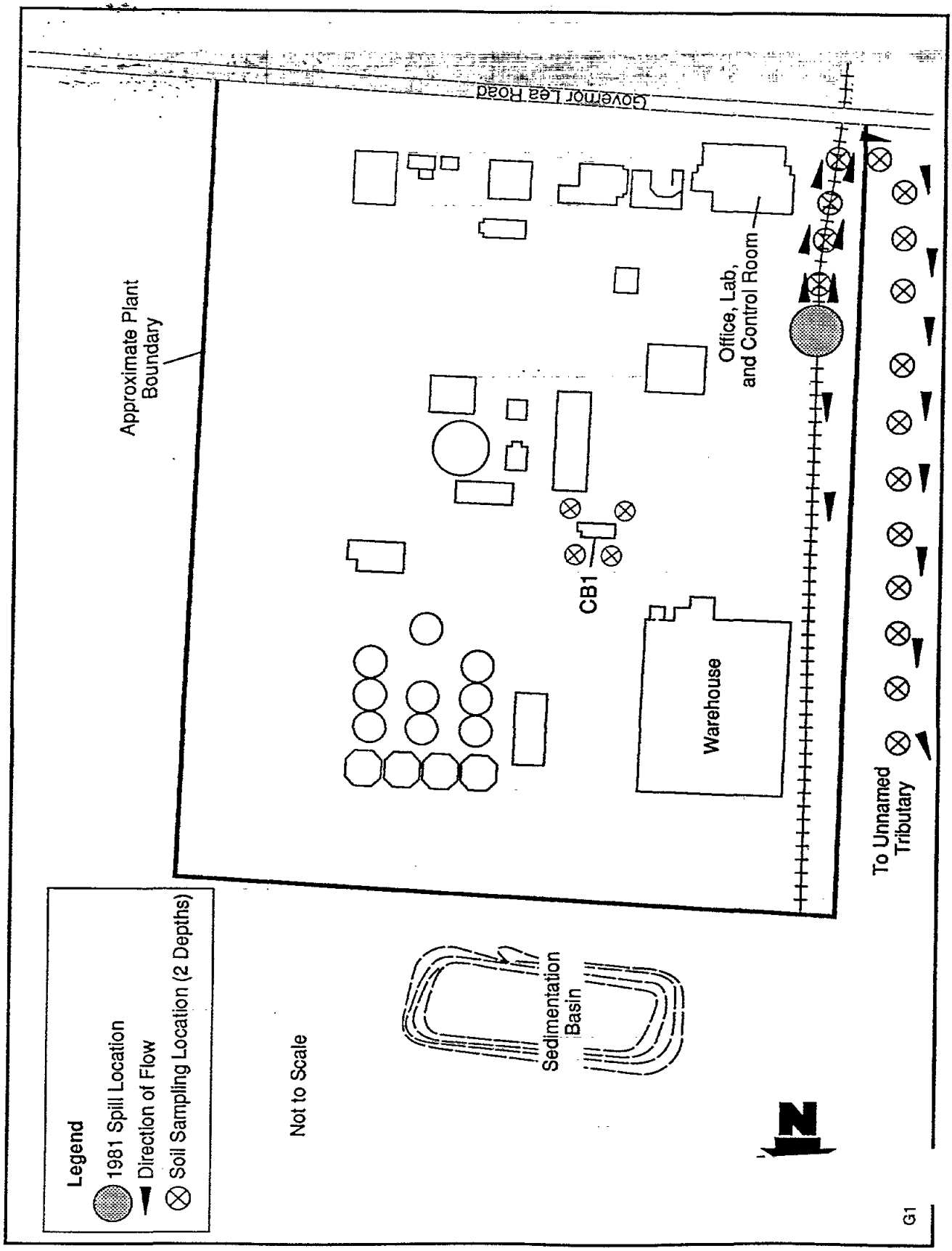


FIGURE 5-1 SOIL SAMPLING ALONG 1981 SPILL FLOW PATHWAY STANDARD CHLORINE OF DELAWARE, INC.

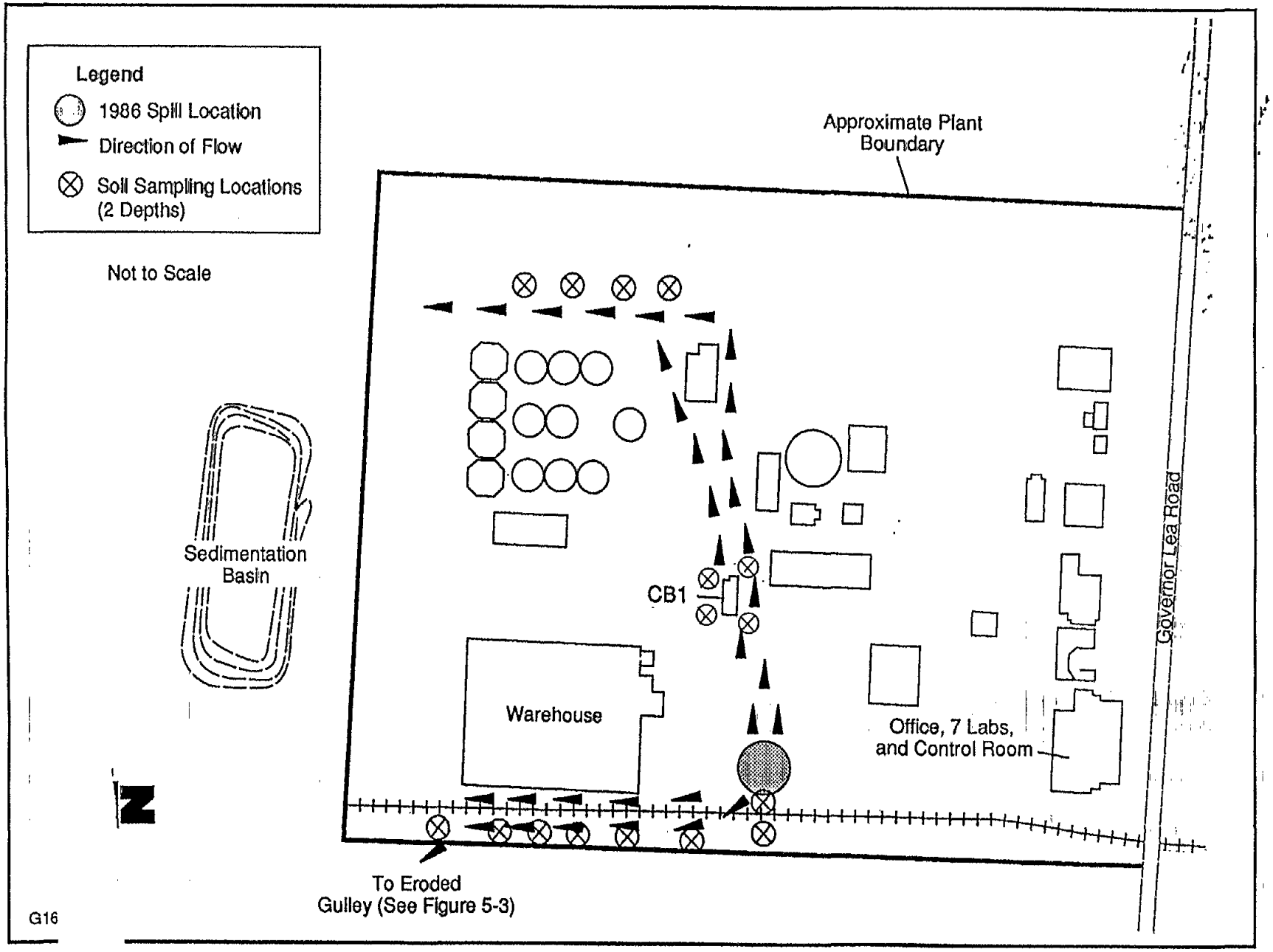


FIGURE 5-2 SOIL SAMPLING ALONG 1[illegible] SPILL FLOW PATHWAY STANDARD CHLORINE OF [illegible]AWARE, INC.

- 50 foot intervals along the eroded gulley (800 foot length) since product recovery was more difficult in this steeply-inclined area (see Figure 5-3)

- Sediment sampling of the wetlands area which will be discussed in subsection 5.4.1.

o Easterly flow path:

- 100 foot intervals along the eastern boundary drainage ditch (approximate 400 foot length) since it is not anticipated that liquid product may have even reached this point, due to freezing conditions.

It is estimated that a total of 56 soil samples will be collected during this task: 2 samples at each of the 28 locations along the 2000 foot flow patterns described above.

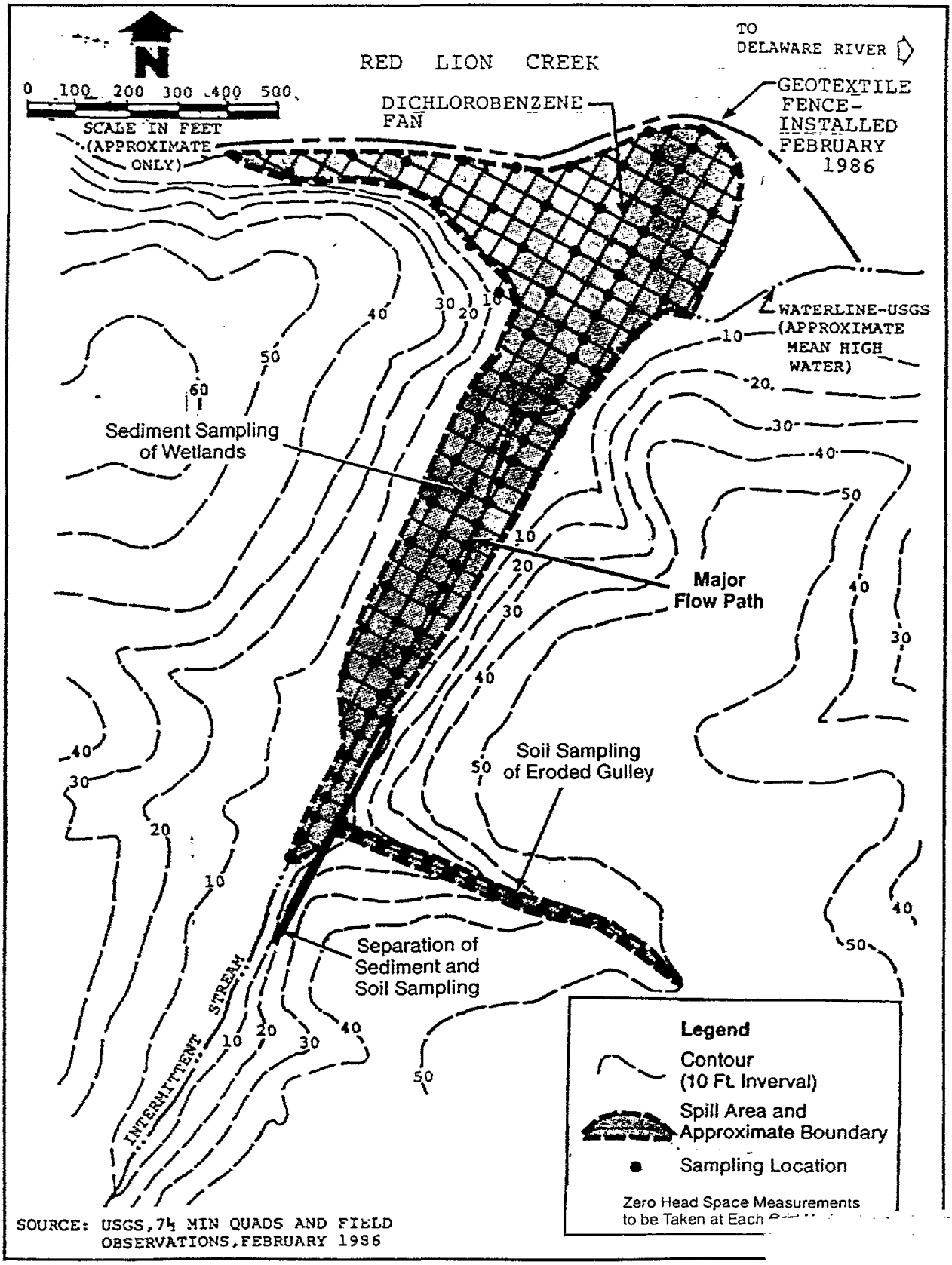
5.2.3 Catch Basin #1 (CB1)

Miscellaneous soil sampling will also be conducted near CB1 to verify the effectiveness of replacing the basin and nearby connecting piping following the 1976 CB1 leaking incident. Four sampling locations will be selected near CB1 during the field mapping effort from which two soil samples will be collected at each location. At this time, it is anticipated that the deep sample will be collected from a depth approximately 10 feet below the bottom elevation of CB1 (which is approximately 10 feet) and the shallow sample depth is undefined. Based on OVA/HNu monitoring readings taken from headspace and visual observations of the lithologic samples, the depths of sample collections for chemical analysis will be ultimately determined. It is estimated that a total of eight soil samples will be collected for this task. Chemical analysis and sampling procedures are specified by the QAPjP.

Miscellaneous soil sampling will also be conducted from the area of potential runoff from the soil piles storage. Discussion of this activity is presented in subsection 5.7

5.3 SOIL BORING

A total of 14 soil borings are proposed for installation at SCD. Four of those borings will be located near CB1, as described in subsection 5.2.3; the remaining ten borings will be drilled in anticipation of the installation of ground water monitoring wells, as shown in Figure [illegible]



SOURCE: USGS, 7½ MIN QUADS AND FIELD OBSERVATIONS, FEBRUARY 1986

FIGURE 5-3 SAMPLING GRID FOR ERODED GULLEY AND UNNAMED TRIBUTARY OF RED LION CREEK

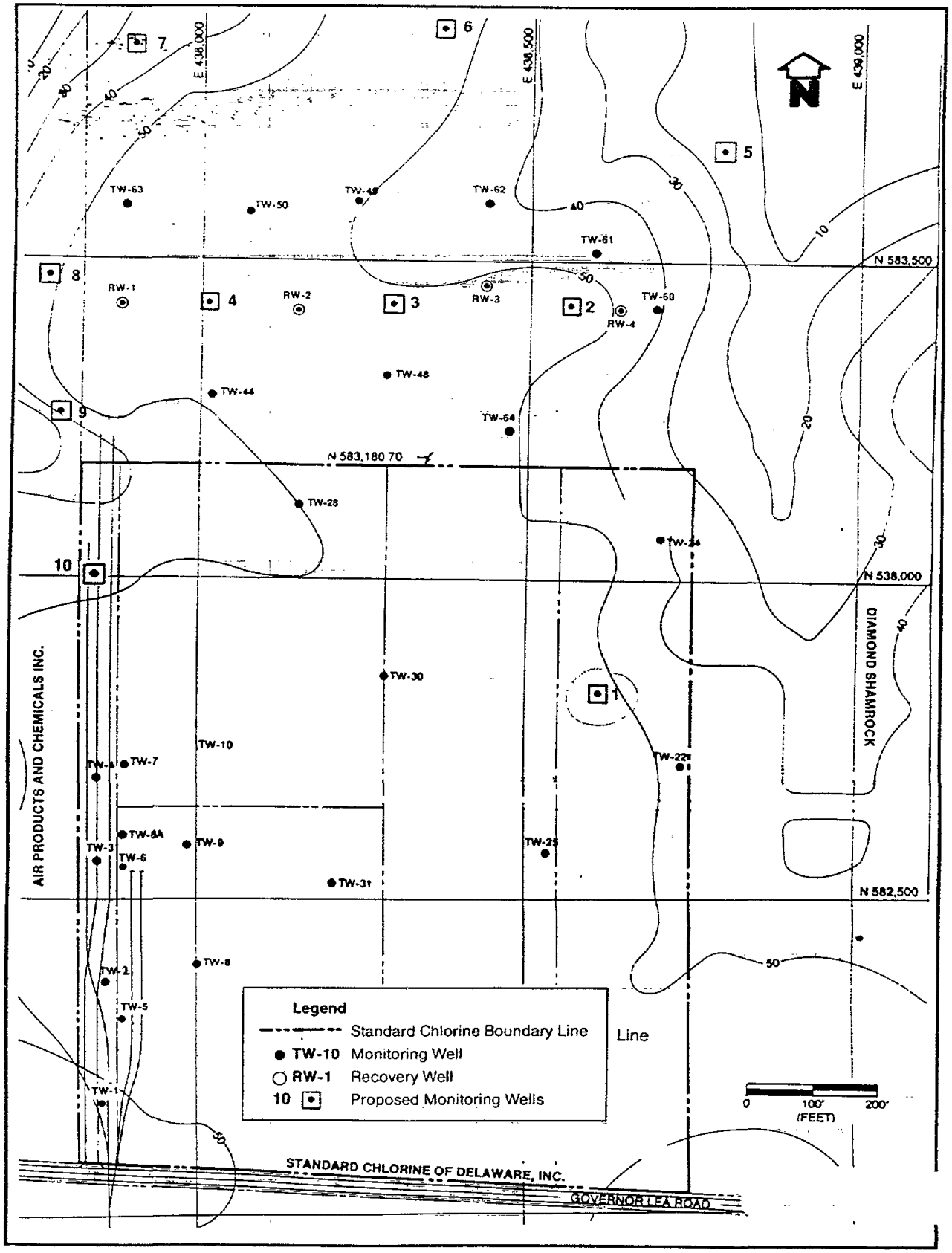


FIGURE 5-4 LOCATION OF EXISTING AND PROPOSED COLUMBIA FORMATION MONITORING WELLS

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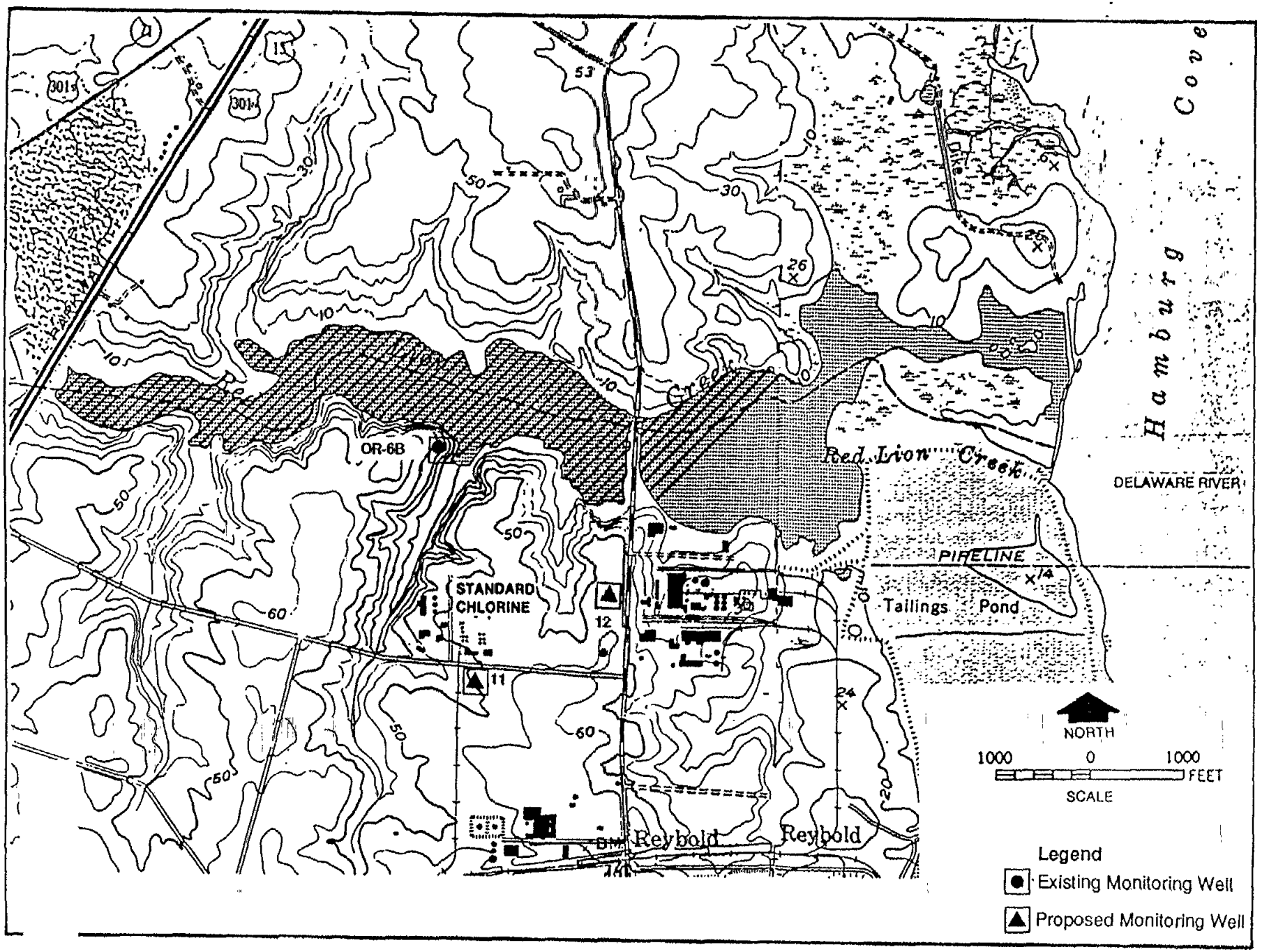

FIGURE 5-4A LOCATIONS OF EXISTING AND PROPOSED UPPER POTOMAC AQUIFER MONITORING WELLS

described in subsection 5.6.1. The ten soil borings are planned to confirm the presence of the Potomac confining clay and to collect lithologic soil data. The soil borings will be completed using hollow stem auger techniques. Split spoon samples will be taken at 5 foot intervals for lithologic classification of soil profiles. At approximately 50 feet below the surface, continuous split-spoon samples will be taken to a depth of 3 feet into the Potomac clay. Split spoon samples will be monitored for volatile organic compounds. In the event that a vapor detection level exceeds ten times the background levels, a soil sample will be taken for chemical analysis. Specific protocols for soil borings and lithologic sampling are given in the QAPjP.

5.4 SEDIMENT INVESTIGATION

The sediment investigation will focus on two separate areas: the wetlands area in the unnamed tributary extending to the filter fence, and the Red Lion Creek area from Route 13 to just east of Route 9. Specific details on the sediment investigation to be conducted in the wetlands area are provided in the following subsections; details on the sediment investigation to be conducted in Red Lion Creek are provided with the discussion of the surface water investigation in subsection 5.5. Sediment samples will also be taken of the material contained in the sedimentation basin and the soil piles (see subsection 5.7).

5.4.1 Wetland Sediment Investigation

5.4.1.1 Field Mapping and Site Reconnaissance

Prior to any sediment sample collection in the wetlands area, a field mapping and reconnaissance program will be conducted to obtain information on the near-surface sediment profile and contaminant distribution. This program will include a full wetlands delineation, the results of which will be used to further select the sediment sampling locations. Information generated by the Biota Investigation (flora, subsection 5.9.1) will also be included in this wetlands delineation.

In order to characterize the eroded gulley and unnamed tributary with minimal disturbance to the wetlands, a surface soil organics screening program will be conducted. Shallow hand auger cores will be taken of the first 1 to 2 feet of sediment below ground surface at each of the survey grid nodes shown in Figure 5-3. Each soil core

screened with an OVA/HNu, and a description of the soil profile, including any observed contamination, will be recorded. It is anticipated that 100-150 locations will be screened.

5.4.1.2 Wetlands Sediment Sampling

According to the results of the field mapping and reconnaissance program, sediment samples will be collected in the wetlands area. For estimation and planning purposes, sampling locations were designated (see Figure 5-3). Sampling locations were designated at 50-foot intervals along the major flow path of the 1986 spill, and at 100 foot intervals on either side of the major flow path. The justification for this sampling scheme is that the product flow would most likely be heaviest along the centerline and would dissipate radially. More exact locations will be designated during the field mapping. In particular field-designated sampling locations will be selected to examine the effect that placement of the tidal gate has had on partially exposing previously submerged sediments (refer to subsection 5.9 Biota Investigation for more detail). The soil samples will be collected at a depth interval based on the results of the OVA/HNu screening and visual observations of the soil cores.

All samples will be sampled and analyzed according to QAPjP requirements. It is estimated that a total of 50 sediment samples will be collected during this task.

5.5 SURFACE WATER INVESTIGATION

5.5.1 Surface Water Sampling

The surface water investigation will cover Red Lion Creek, for a distance of approximately 6,200 feet, bounded by Route 13 to the west and extending approximately 200 feet east of Route 9 (see Figure 5-5). This investigation area was selected based on two criteria: (1) the discharge of the wetlands area and unnamed tributary into Red Lion Creek; and (2) the tidal influence of the Delaware River on Red Lion Creek, thereby spreading any potential contamination in the creek similar to an alluvial fan.

Seven surface water locations will be sampled along Red Lion Creek as shown in Figure 5-6. Three additional surface water samples will be collected along the unnamed tributary. It is anticipated that a total of 10 surface water samples will be collected and analyzed according to the methods specified in the QAPjP.

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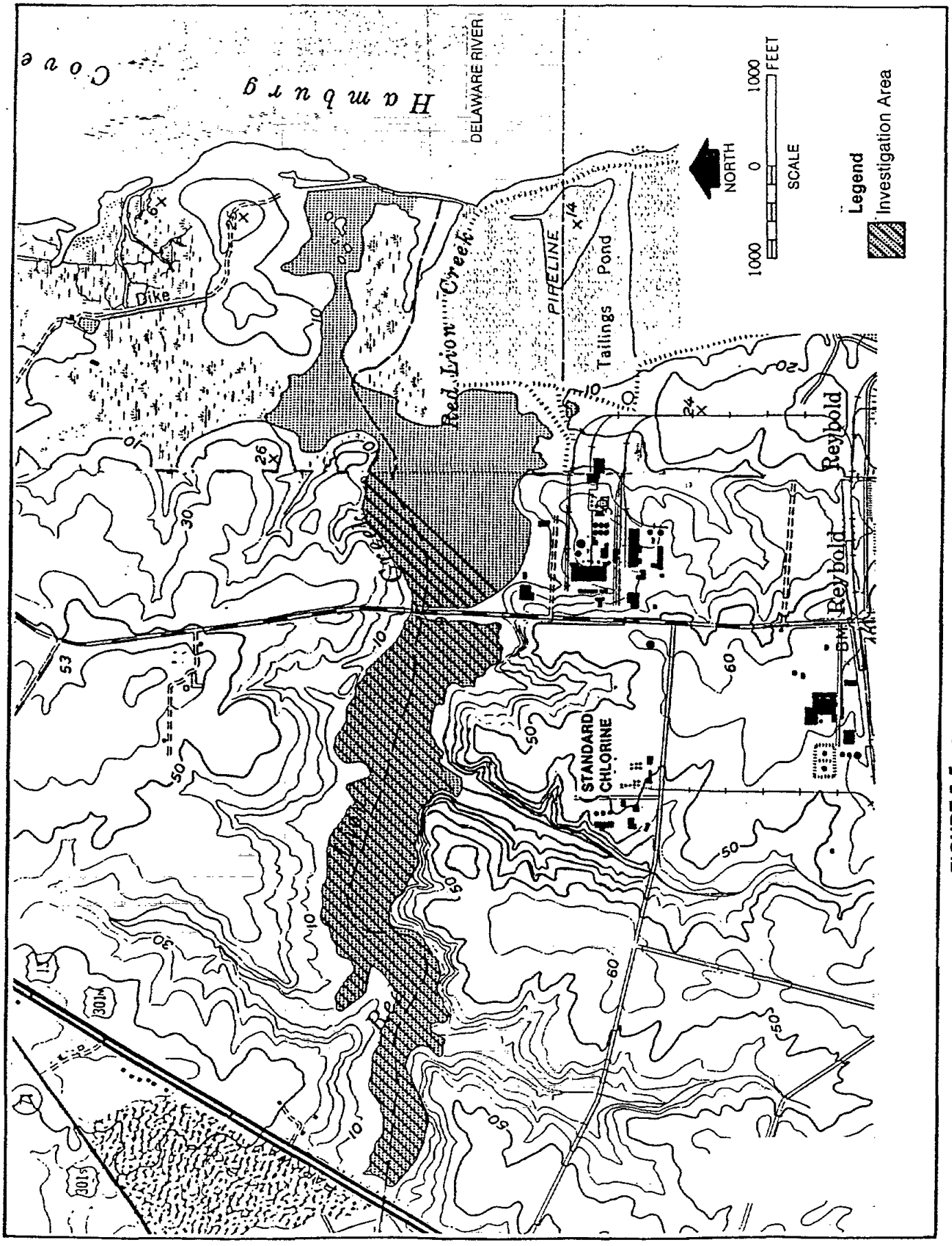


FIGURE 5-5 SURFACE WATER INVESTIGATION AREA

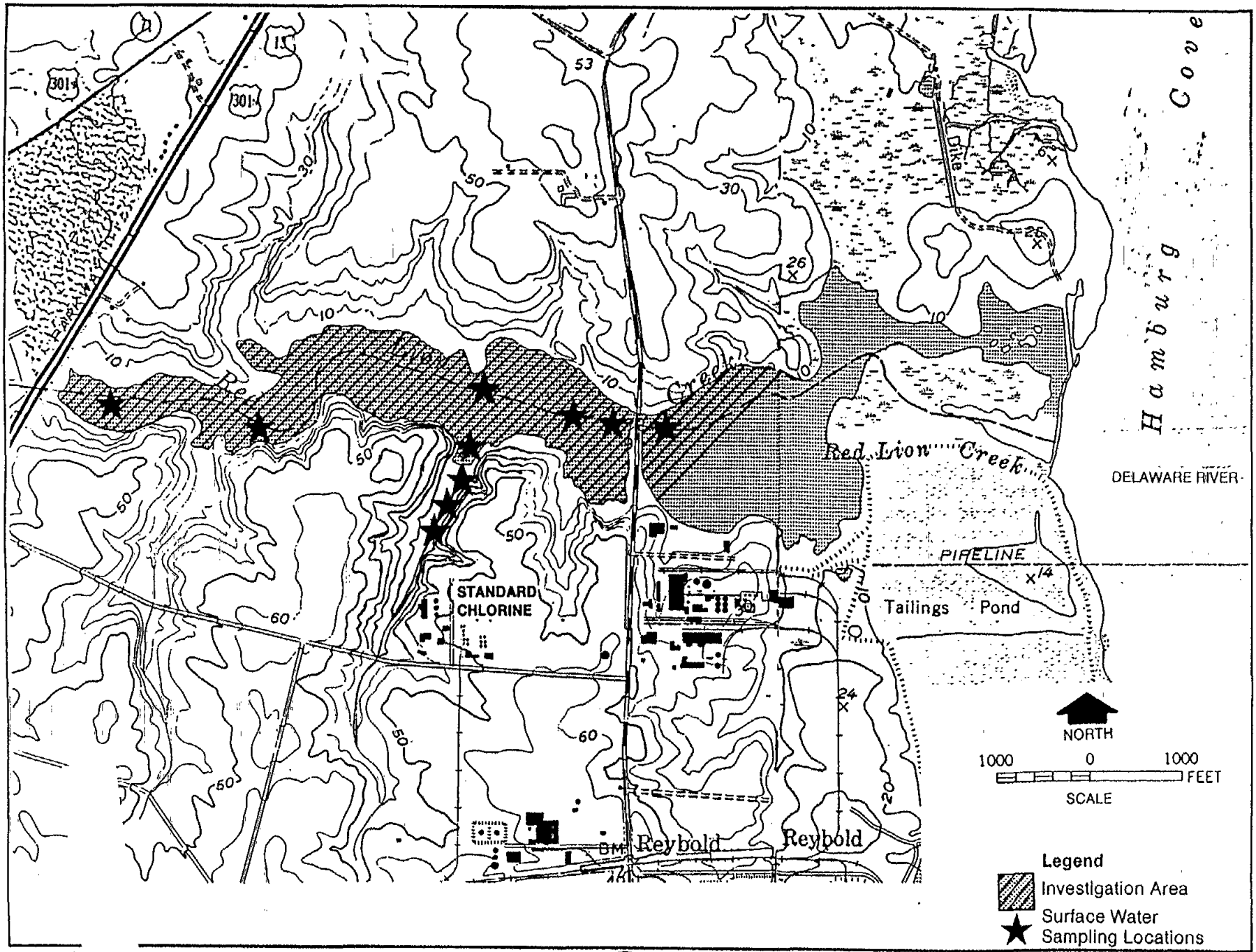


FIGURE 5-6 SURFACE WATER SAMPLING LOCATIONS

5.5.2 Red Lion Creek Sediment Sampling

Fifteen sediment locations in Red Lion will be sampled, as shown in Figure 5-7. Seven of the sediment samples will be collected simultaneously with the corresponding surface water samples (from the same location). The sediment samples will be collected according to the protocols specified by the QAPjP and will be analyzed according to the scheme presented in the QAPjP.

5.5.3 Flooding Potential/Drainage

As an additional part of the surface water investigation, the following information will be gathered to facilitate evaluation of the potential for additional surface water contamination.

- Classification of the adjoining site areas with respect to floodplain status, as determined by the Federal Emergency Management Administration (FEMA) floodplain guidelines.
- Location of wetland areas associated with surface waters adjacent to the plant site.

The surface water pathway was of major importance during both spill events. Each time, SCD implemented control and containment measures for the spilled material. Since the 1986 spill, SCD has developed a Spill Control Plan, which delineates drainage areas and pathways and identifies appropriate containment measures for the site. (This plan was submitted to DNREC on July 22, 1988 in accordance with paragraph 14 of the Consent Order). Since this plan is available, drainage pathways on-site will not be investigated during the RI, although they may be a consideration during the FS (site grading, etc.).

5.6 GROUND WATER INVESTIGATIONS

The ground water investigation phase of this RI will focus on supplementing existing data at the facility. The tasks to be completed in this phase will include installation of Columbia Formation monitoring wells at the ten boring locations discussed in Section 5.3; an indepth review of hydrogeologic characteristics and use of the Potomac aquifer in the site vicinity; installation of two monitor wells in the upper Potomac aquifer; performance of a pump test in the upper Potomac aquifer; an evaluation of the effectiveness of the ground water recovery system; and sampli[illegible] existing and newly installed monitor wells and recovery wells.

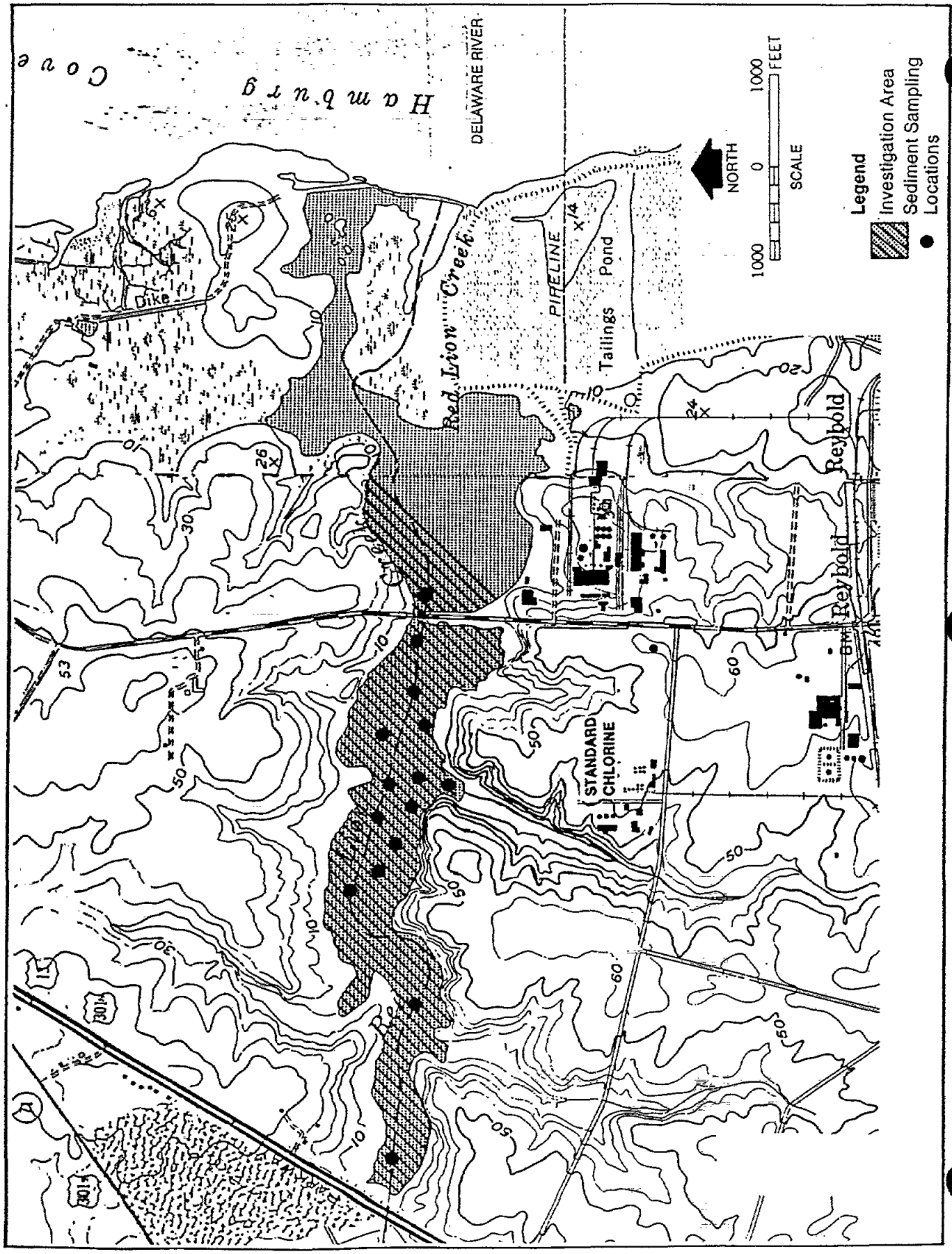


FIGURE 5-7 SEDIMENT SAMPLING LOCATIONS

5.6.1 Well Installation

The proposed monitor wells shown in Figure 5-4 and 5-4A are located at strategic positions to more accurately define the ground water flow patterns and the migration of the contaminant plume, and to assess ground water quality in the vicinity of the SCD facility. The specific purpose for each monitor well location is summarized in Table 5-2. Four inch diameter monitoring wells will be installed at each location. The Columbia Formation monitor wells will be screened for 10 feet at the base of the Columbia. Monitor wells installed in the Potomac Formation will be double cased wells, and will be screened in the upper Potomac aquifer. Specific details on well construction techniques are presented in the QAPjP.

A lockable well cap will be installed on each well for security purposes. All wells will be developed according to QAPjP stipulations; development water will be collected and treated in the facility water treatment plant and the wells will be allowed to recover for two weeks prior to any sampling activities.

A complete round of water level measurements will be taken from all the site monitor wells, Star Enterprise observation wells OR-6B and OR-6A, Occidental wells A17 and A21 (if accessible), and the recovery wells, and from four stream staff gauges to be established in the unnamed tributary and Red Lion Creek (i.e. two gauges in each creek). This hydraulic data will be used to define ground water flow patterns in the Columbia Formation and upper Potomac aquifer, and to determine the relationship between ground water and surface water at the site vicinity.

5.6.2 Pump Test

A pump test will be conducted on the Star Enterprise well OR-6A that is screened in the upper Potomac aquifer. The data generated from the pump test will be used to determine aquifer and confining unit characteristics in the vicinity of the SCD facility, and to evaluate the potential impact of ground water contamination at the SCD site on the upper Potomac aquifer.

Prior to commencement of the pump test, calculations using the upper Potomac aquifer characteristics will be conducted to predict the anticipated influence on Columbia and Potomac aquifer wells from pumping Star Enterprise well OR-6A at both low and high confining unit leakage rates. The pump test will be of sufficient length and magnitude to

TABLE 5-2

Rationale for Proposed
Monitor Well Locations

Well	Rationale
1	Further definition of topographic low in the top of the Potomac clay and provide additional data on ground water quality, particularly the presence of a dense non-aqueous phase liquid.
2,3,4	Provide water level and water quality to assess the effectiveness of the ground water recovery system.
5,6,7	Provide additional information on water levels, ground water quality and geologic stratigraphy in the Columbia Formation north of the recovery wells.
8,9,10	Provide additional information on water levels, ground water quality and geologic stratigraphy in the Columbia Formation west and southwest of the recovery wells.
11, 12	Provide water level and water quality data to determine the ground water flow direction, and water quality conditions of the upper Potomac aquifer.

the desired stress on Columbia and upper Potomac wells as predicted by the above mentioned calculations. The discharge rate and duration of the pump test will be finalized pending discussions with the appropriate DNREC project representatives.

Prior to and during the pump test, water level responses will be continously monitored at the pumping well, and several upper Potomac and Columbia monitor wells.

These monitor wells will include Star Enterprise observation well OR-6B, Occidental's upper Potomac wells A17 and A21, the two new upper Potomac monitor wells to be installed during the RI, and several Columbia wells on SCD property.

SCD will have to obtain permission from Star Enterprise and Occidental Chemical to utilize the wells on their properties for the pump test and water level monitoring. Once permission is obtained, SCD will field evaluate the Star Enterprise and Occidental wells A17 and A21 to verify their acceptability for conducting the test.

Specific details on the pump testing procedures are presented in the QAPjP.

5.6.3 Review of Available Potomac Aquifer Data

An indepth review of available data on the Potomac aquifer will be performed during the RI to supplement hydraulic data generated during the pump test and to further characterize the upper Potomac aquifer in the vicinity of the SCD facility. Available data will be investigated, including:

- Potomac wells in the vicinity to investigate location, water quality, water level and depth.
- Well log information to confirm the extent of the confining clay layer.
- Pumping rates and influence of Potomac wells on flow direction.
- Hydraulic characteristics of the Potomac and Columbia Formations.

Based on the results of the study, the groundwater flow direction of the upper Potomac aquifer in the vicinity of the SCD facility will be estimated along with the potential for contaminant migration through the confining cl

5.6.4 Evaluation of the Ground Water Recovery System

The ground water recovery system will be evaluated by analyzing drawdown data and estimating the capture zone of the system. The results of the recovery system assessment will be used to support the development of remedial alternatives.

5.6.5 Ground Water Sampling

Two weeks following development of the newly installed monitoring wells, all existing and new monitor wells, the four recovery wells, and Star Enterprise observation well OR-6B will be sampled for chemical analysis. Prior to sampling, water level elevation measurements will be taken in all wells. Wells will be sampled once before and once after purging (one static and one dynamic sample) with the exception of the three Potomac monitor wells which will be purged prior to sampling. Sampling protocols and chemical analyses are specified in the QAPjP. It is anticipated that a total of 63 ground water samples will be collected for this task: 2 samples from each of the 30 Columbia wells, and one from each of the three Potomac wells, as specified by the QAPjP.

5.7 SOIL PILES AND BASIN

The soil piles and sediment basin are located on Occidental Chemical property north of the SCD facility and adjacent to the unnamed tributary of Red Lion Creek. Constructed during the 1986 spill cleanup effort, the three soil pile areas consist of excavated wetland soils which were piled and covered with Visqueen for later handling. The basin was constructed with a double geomembrane liner system to hold the soils and water dredged from the wetlands area.

Figure 5-8 shows the location of the soil samples to be collected from the runoff areas downslope of the three soil piles. Due to the heterogeneity of these piles, characterization of the soil piles will be performed by collecting a composite sample comprised of 5 grab samples from each pile. Details are presented in the QAPjP.

Approximately 20 soil samples will be collected from locations in the surface run-off drainageways below the soil pile areas. The exact location of these samples will be determined after visual inspection of the area. The total number of soil samples to be collected and analyzed in this task, then, is approximately 23. All samples sampled and analyzed according to QAPjP requirements

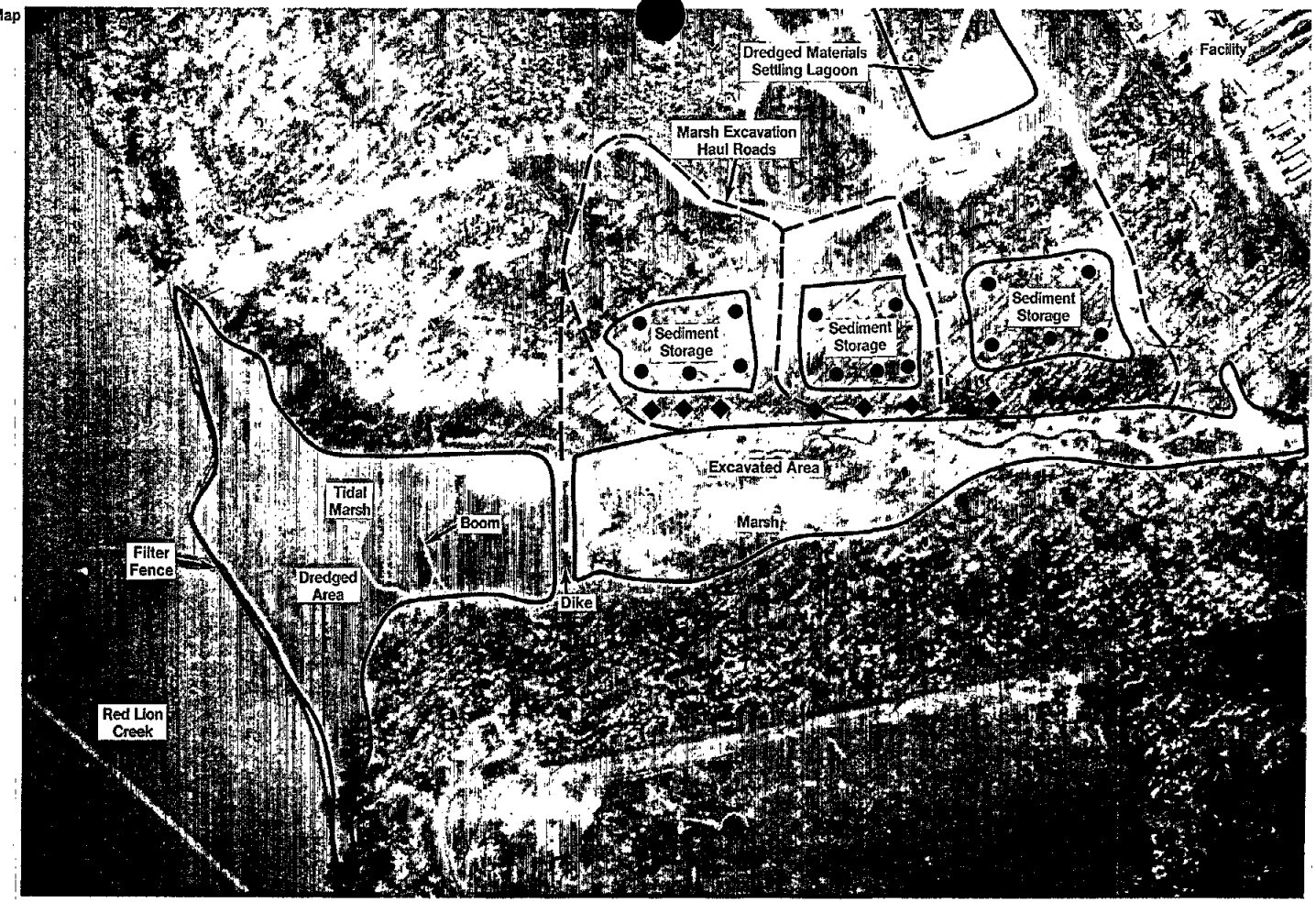


FIGURE 5-8

ATIONS
ORAGE PILES

Two water samples and one sediment sample will be collected from the sedimentation basin. The water samples will be collected from the witness zone in between the double liner system at the basin. The sediment sample will be composited from three grab samples which will be collected from the sediment contained within the basin. If the witness zone is found to be contaminated, a separate work plan will be prepared for additional investigations regarding basin integrity and possible contamination of runoff areas downslope from the soil piles. Detailed protocol for sample collection and analysis are presented in the QAPjP.

5.8 AIR INVESTIGATION

The purpose of an air investigation is to characterize any airborne emissions of hazardous materials from the site which may pose health or environmental hazards.

At the time of the spill releases in 1981 and 1986, the potential ambient air impacts were greatest. However, these potential impacts decreased with time in both instances as the spill response work progressed. The ambient air impacts reflected short transient events which are no longer applicable as potential pathways.

A 1983 report to evaluate the potential air quality impacts from the ground water recovery operation was prepared. The only potential air emission cited by the report was from the air stripper. (The remedial treatment system implemented by SCD employs an air stripper, with exhaust gases vented to a plant boiler.) This air discharge is conducted under an approved air permit. The potential air impact associated with emissions from this system were evaluated in a previous technical report. This technical evaluation indicated that the air emissions associated with this remedial action are environmentally acceptable. As described previously, subsequent to the spill events and completion and/or installation of remedial measures, the ambient air quality at SCD was investigated by DNREC and was found to be well below occupational standards. Therefore, only personnel protective monitoring is proposed for the RI, particularly in the vicinity of the soil piles and the sedimentation basin.

5.9 BIOTA INVESTIGATION

The RI includes an evaluation of the biota in the vicinity of the site in order to identify species and habitats which may be at risk from the identified contaminants.

A retrospective evaluation of the direct effects of the 1981 spill on area biota is not feasible. However, information on the recent status of the flora and fauna in the general area of Red Lion Creek can be derived from the investigations conducted following the 1986 spill.

5.9.1 Flora

Plants may be generally considered to be on the average less sensitive to toxic materials than animals. In fact, wetland plant communities have been used to treat waste water as part of remedial actions (Staubitz et.al., 1988). Following the cleanup of chlorinated benzenes completed in the spring of 1986, the excavated areas of the marsh began to be recolonized by vegetation. The majority of the excavated cleanup area was found to be colonized by wetland plants by the fall of 1987. Field observations at that time did not suggest that plant distribution was related to the distribution of residual concentrations of chlorinated benzenes, but rather dredge and sedimentation patterns.

The marsh area downstream of the berm has been strongly affected, since the spill incident, by the reconstruction of a tidal gate at the mouth of Red Lion Creek. This tidal gate allows discharge of the creek to the river but does not allow an inflow of tidal water into the creek. This has a net effect of reducing the water elevation by a few feet below the previous high tide level. Therefore, former shallow tidally flooded areas are now always drained and exposed. These areas have consequently been colonized by wetland plants from higher elevations of the former intertidal zone. The spill area dredged to remove product is within this affected shallow tidally flooded area. Perhaps half of the area remains bare at this time with the slightly lower and wetter elevations (centered on the dredge passes) colonizing more quickly.

During the remedial investigation, wetland plant communities within the spill area and between Route 13 and Route 9 will be mapped from current aerial photography and field verification. Such plant community maps will provide for:

- Comparison of plant distribution and residual chlorinated benzene concentrations to determine any possible toxic effects.
- A survey of plants (during field verification) for evidence of visible stress which may be related to concentration patterns of chlorinated b

- A description of wetland communities and habitats from which to base initial estimates of value or function to be used when assessing the need versus impact of remedial actions beyond the previous cleanup area (containment fence). The mapping will also provide a baseline for potential ecological risk assessments which may be warranted from the chlorinated benzene levels to be found in creek water, wetland sediments and fish tissue.

- Documentation of the effects of the tide gate installation on tidal influence within the spill area. This change in hydrology is very important to the migration of spill material which occurs beyond the previous clean up area (containment fence). This material once migrating under tidal influence is now beyond tidal action in areas of high marsh and is most influenced by high stream flows and other storm events.

Although no sampling of plant tissue is proposed at this time, the ecological portion of the endangerment assessment may indicate the need for further investigation.

5.9.2 Fauna

For the remedial investigation, fish samples will be collected for tissue analysis at two locations on Red Lion Creek, as indicated on Figure 5-9. Zone A will be located immediately east of U.S. Route 13, and Zone B will be located immediately east of U.S. Route 9. Actual sample locations and methods to be utilized will ultimately depend upon conditions observed at each location at the time sampling. Samples will be collected as specified in the QAPjP. Both whole body and filet samples will be processed to determine ecological and human health risks. Fish tissue collection, preservation, and analysis will adhere to the QAPjP based on EPA's Sampling Protocols for Collecting Surface Water, Bed Sediment, Bivalves, and Fish for Priority Pollutant Analysis (US EPA, 1982).

At both locations, two species, if present in sufficient numbers, will be retained for tissue analysis. Every effort will be made to keep consistent those species selected during each sampling effort. The two species will represent two distinct trophic levels, i.e., a bottom feeder or forage fish, and a predator, preferably an edible game fish.

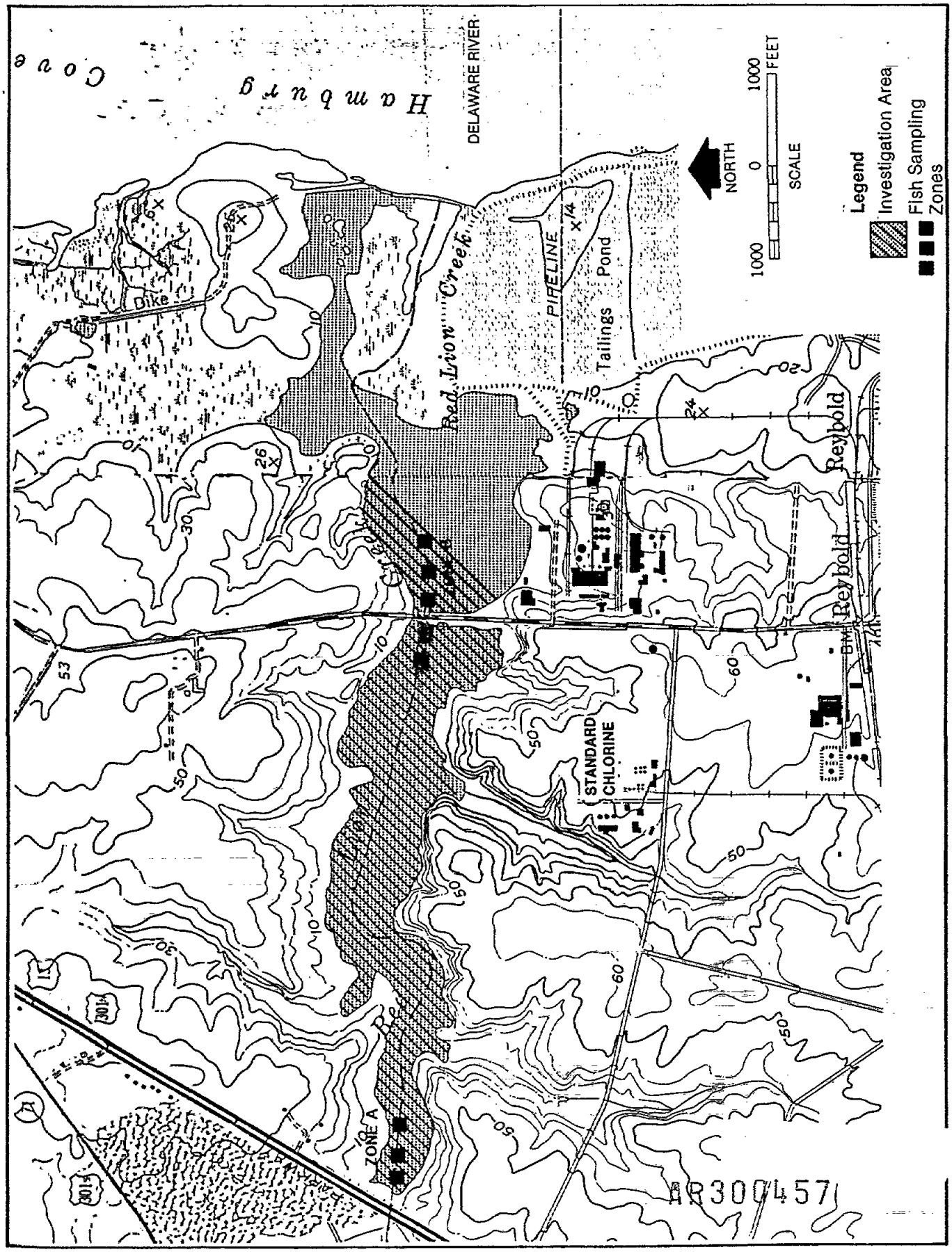


FIGURE 5-9 FISH SAMPLING LOCATIONS

Preferred species are the white perch (as the predator) and the channel catfish or white catfish (as the bottom feeder). If these two catfish are not abundant enough, the brown bullhead is recommended. If an insufficient number of fish are collected, indigenous invertebrate species, including blue crabs, crayfish, annelids or bivalves, may be collected. Specific protocol for the fish sampling are given in the QAPjP.

5.10 DATA REDUCTION AND REPORTING

The analytical data for the SCD RI/FS will consist primarily of that generated during the RI field work, since the present-day site conditions will be basis for remediation. Depending upon a judgement on the quality of past analytical data, that past data may also be used only in a qualitative sense to supplement the data collected for this RI. Data reduction and reporting are discussed in detail in the QAPjP.

5.11 PUBLIC HEALTH AND ENVIRONMENTAL CONCERNS

5.11.1 Potential Receptors

The issue of potential receptors will be discussed in detail once the data from the RI has been generated and compiled. The issue will factor heavily into the selection of the appropriate remedial alternative for the FS.

5.11.2 Risk/Environmental Assessment

As the RI data are compiled and presented, the scope for the Risk/Environmental and Ecological Assessment can be better defined. The specific details of the toxicity tests (ie. type, number, etc.) will be developed during this scoping. It is proposed that a separate work plan be prepared for this work element and submitted for approval.

SECTION 6

FEASIBILITY STUDY

The purpose of the Feasibility Study is to evaluate options for the management, mitigation and control of environmental impacts posed by site contaminants. Based on our current understanding, this contamination is resulting from the 1981 and 1986 spills and past leaking of Catch Basin No. 1. In the Feasibility Study, each candidate technology is screened in terms of technical and non-technical factors. Potentially applicable technologies, based upon this screening evaluation, are then combined into remedial action alternatives, and these alternatives are compared for expected effectiveness and relative costs.

6.1 PREVIOUS FEASIBILITY STUDY ACTIVITIES

As previously presented in this work plan, remedial actions have already been taken in response to the 1981 and 1986 spill incidents and the leaking of Catch Basin #1. The ground water recovery and treatment system initiated in response to the 1981 spill was preceded by a feasibility study. The excavation and dredging activities performed in response to the 1986 spill and in response to the 1976 leaking of Catch Basin #1 (CB1) were not preceded by a feasibility study since these activities were enacted as emergency response measures.

This feasibility study will investigate the remedial alternatives applicable to the current site conditions. The no action alternative, which includes an evaluation of remedial actions already taken, will be evaluated as part of the FS process. It becomes particularly relevant for this site since substantial cleanup has already been completed and ground water recovery and treatment is underway.

6.2 SCREENING OF REMEDIAL ACTION TECHNOLOGIES

In this section of the Feasibility Study, potentially applicable technologies for the control or mitigation of the site impacts, as determined by the characteristics of he contaminants and their distribution, will be screened. Technologies will be screened based upon technical considerations, and nontechnical factors. The requirements of SARA Section 121 will be considered in this technology screening. Using this screening process, technol
either be rejected from consideration or be ret
further consideration in Remedial Action Alternati.

Technology evaluations were previously performed as part of the past development of remedial alternatives for the site (as a result of the 1981 spill). Based upon the known results of those previous investigations and the requirements embodied in the US EPA "Guidance on Feasibility Studies under CERCLA" and SARA Section 121, technologies considered and screened previously will be reviewed and the screening work updated.

Table 4-2 presented a listing of general response actions and possible technologies for consideration during technology screening.

6.3 PERFORMANCE CRITERIA AND STANDARDS FOR REMEDIAL ALTERNATIVES

In this section of the FS, remedial action objectives are developed based upon the contaminants and media of interest, exposure pathways, and remediation goals. For SCD the remedial action objectives will address contaminant concentrations in soils, sediments, ground water, and, potentially, surface water, depending upon the results of the RI. Based upon current knowledge of the site, chlorobenzenes have been highlighted as the contaminant of concern. The objectives will be based on the applicable or relevant and appropriate requirements (ARARs) and risk-related factors. Remedial alternatives will only be selected which will attain these remedial action objectives (i.e., the performance standard).

6.4 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Individual technologies which were determined to be potentially applicable in the screening analysis will be combined into alternative systems for site remediation. The alternatives will represent a range of treatment and containment combinations, as appropriate, and including the no action alternative, to attain the remedial action objectives developed earlier.

6.5 TREATABILITY STUDY/PILOT TESTING (Optional)

Treatability and/or pilot scale testing may be required as part of the FS, or, possibly, during the RI, for the purpose of evaluating alternative treatment systems and/or establishing preliminary design and operating parameters. Bench and/or pilot tests may be conducted to determine the effectiveness of treatment technologies esp
applied to the site-specific conditions at SCD
time the scope, timing or need for bench/pilot t
not be determined and additional details cannot be included

in this work plan. In the event that this type of testing is recommended, a scope of work will be prepared for DNREC approval.

6.6 REMEDIAL ALTERNATIVE SCREENING

If numerous waste management options are developed during the development of remedial alternatives, it may be necessary to screen alternatives to reduce the number which must be analyzed in detail. Alternatives may also need to be considered in light of multi-media impacts and sitewide risks reduction. Also, as a result of this screening, the alternatives may be modified with respect to technologies used or quantity of media affected.

6.7 REMEDIAL ALTERNATIVE DETAILED ANALYSIS

Following the screening of alternatives, those alternatives judged to be most applicable will be identified and evaluated in detail. This evaluation will consider the potential performance of alternatives with respect to remediation, overall cost benefit, their implementability and constructability, and their environmental implications. Each remedial alternative will be evaluated under the following criteria:

- Technical Considerations
- Environmental and Public Health Considerations
- Institutional Considerations

The remedial evaluation will consider safety relating to implementation, reliability, long term ability to achieve results and degree to which waste recycle/destruction/-treatment is achieved. Other non-technical issues relating to each alternative will be reviewed, including effects on the community perception and the ability to obtain permits and meet recovery standards.

The alternatives will be evaluated for environmental and public health effects. The ability of each alternative to mitigate the potential migration pathways and receptor impacts will be evaluated. The environmental benefits of each alternative will be evaluated and any short term impacts associated with implementation will be presented. The ability of each alternative to meet relevant health and environmental standards will be evaluated.

A feasibility level (order-of-magnitude) cost es
be prepared reflecting estimated capital and

associated with each alternative. The cost comparison will also be prepared on a present-worth basis to permit comparison of alternatives embodying varying proportions of capital and O&M costs.

Guidance under SARA and the EPA RI/FS guidance documents indicated that remedial alternatives should include the following:

- o No action; including, as appropriate, site monitoring and security activities.
- o Alternatives representing an appropriate range of treatment and containment combinations.
- o Source control and groundwater control actions as appropriate within the alternatives.
- o Treatment options to the extent feasible within the alternatives to meet the requirements and goals of SARA.

SARA, in general, requires the selection of permanent solutions, to the extent practicable, and encourages the use of alternative technologies in doing so. Treatment alternatives should be included in the FS to minimize to the extent possible the need for long term management.

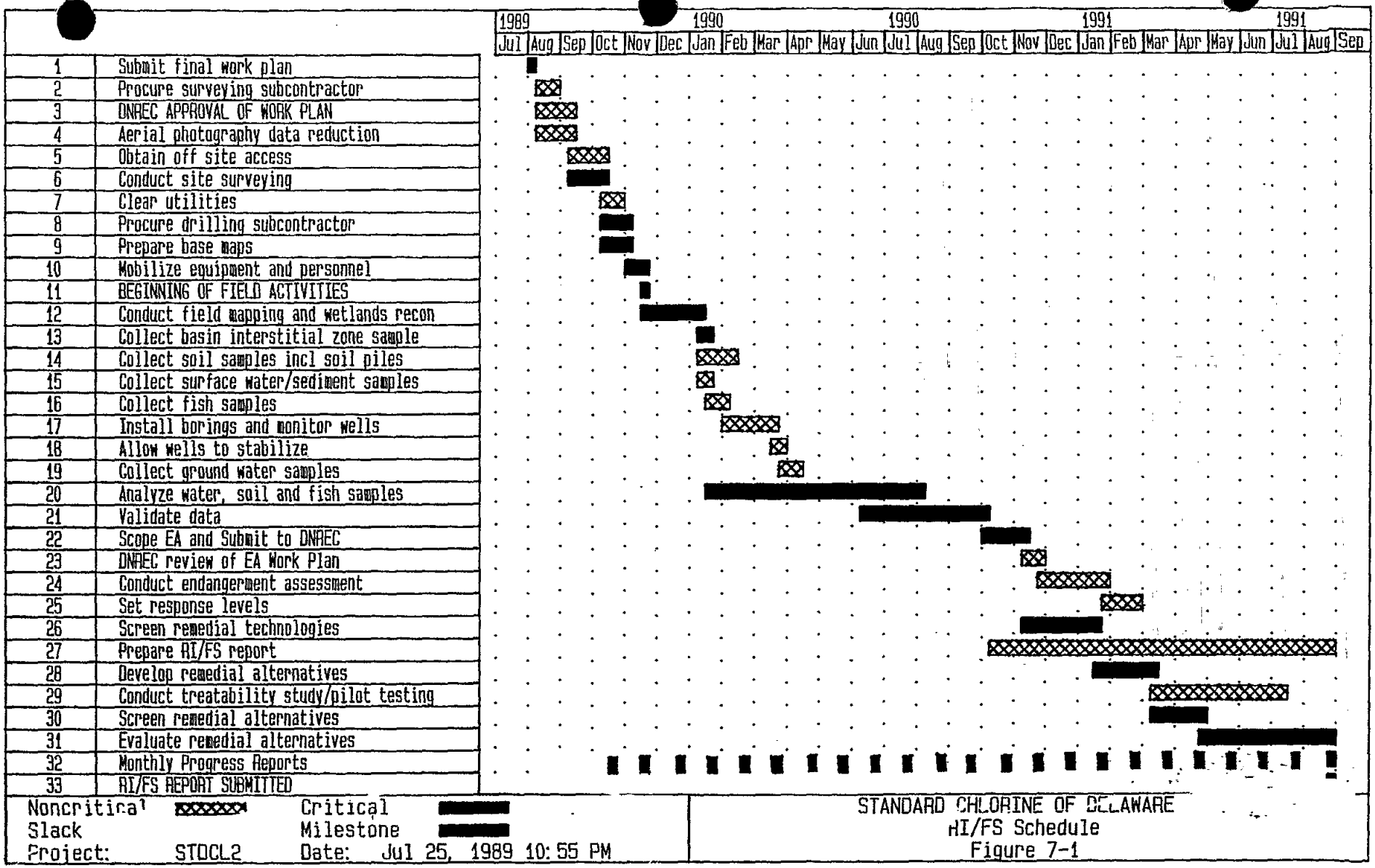
6.8 SUMMARY OF ALTERNATIVES

In this section, the results of the Analysis of Remedial Action Alternatives will be presented in tabular format to facilitate direct comparison of the several options. This comparison will be made in accordance with NCP requirements. Entries in this summary table will include, for each alternative, the present worth, capsule summaries of technical, public health/environmental and institutional considerations, and comments as to potential for achievement of applicable cleanup criteria. Cost-benefit considerations will be included in the alternatives comparison.

SECTION 7

SCHEDULE AND REPORTING

The schedule for execution of the RI/FS tasks is presented in Figure 7.1, and is in accordance with the stipulations set forth in the 14 November 1988 Consent Order between DNREC and Standard Chlorine and Delaware, Inc. The schedule outlines the time period deemed necessary for the successful completion of each task and presents a logical order of progression which charts a critical path for timely project completion. The project schedule has been prepared assuming a date for receipt of DNREC approval of the work plan. Once approval is received from DNREC, the schedule will be revised to reflect the actual DNREC approval date, and the revised project schedule will be forwarded to DNREC.



STANDARD CHLORINE OF DELAWARE
RI/FS Schedule
Figure 7-1

AR300464